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for the Behavioral and Social Sciences

Research Report 1839

Flexible Methods for Future Force Concept Development

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14. ABSTRACT *(Maximum 200 words)*:

One key to the Army's success in transformation will be a solid process for concept development. The Army needs a means to generate, elaborate, refine, describe, test, and validate new concepts relating to doctrine, tactics, techniques, procedures, unit and team organization, job allocation, training, leader development, and other aspects of technology integration. One approach is to construct an environment that transforms the scale in which situations can be presented realistically and to develop, within that environment, a set of tools that can be used to explore selected command group functional performance issues in a methodical fashion. Two tools, a scaled-world tool and a concept-development tool, were designed and developed. In addition, six scaled-world events and 10 concept-development sessions were produced. The scaled-world events and concept-development sessions were formatively evaluated. Based on the evaluation results, it appears that both tools have value for concept identification and concept development. Feedback on both tools was very positive and generally met the project objectives. In addition, future directions for improvements to and use of the synthetic task components are discussed in terms of short-term and long-term requirements and possibilities.

15. SUBJECT TERMS

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Personnel Performance
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FLEXIBLE METHODS FOR FUTURE FORCE CONCEPT DEVELOPMENT

EXECUTIVE SUMMARY

Research Requirement:

The U.S. Army must find methods to rapidly incorporate technology, must make the necessary systemic changes so that future Soldiers can use the assets efficiently and effectively, and must do so at a rate that outpaces our competitors. In short, technology must be introduced to enhance rather than impair operational effectiveness.

A key to success is a solid process for concept exploration. There is a tremendous need for a powerful, yet flexible, approach to concept development and knowledge exploration that can cope with the unique difficulties of envisioning and studying future concepts. The Army needs a means to generate, elaborate, refine, describe, test, and validate new concepts relating to doctrine, tactics, techniques, procedures, unit and team organization, job allocation, training, leader development, and other aspects of technology integration.

Procedure:

Two tools were developed to support elicitation of future tactics. A scaled-world tool and a concept-development tool were designed and developed to examine situations related to the *See* function as it might operate in the future. The tools provide a means to present individuals with situations that stimulate their thinking in the context of realistic situations or to present situations in which only a limited number of variables are operative in order to assess how individuals will perform. Six scaled-world events and 10 concept-development sessions were produced. The scaled-world events and concept-development sessions were formatively evaluated using reviews by military personnel.

Findings:

Based on formative evaluation (FE) results, it appears that both tools have value for concept identification and concept development. Feedback on both components was very positive and generally met the project objectives. One exception is that the components are not as easily modifiable as originally anticipated.

Utilization of Findings:

The results of this project were transitioned to the Unit of Action Maneuver Battle Lab (UAMBL). The tools benefit those involved in the identification, refinement, and testing of concepts related to the Army's transformation to the Future Forces environment. Both tools serve an important function in the initial stages of Future Forces development by providing mechanisms that can be employed in relatively simple settings using existing equipment in order to identify concepts.

FLEXIBLE METHODS FOR FUTURE FORCE CONCEPT DEVELOPMENT

CONTENTS

Page

FLEXIBLE METHODS FOR FUTURE FORCE CONCEPT DEVELOPMENT

Introduction

The U.S. Army is in the process of transforming to a Future Force following the guidelines laid out several years ago by the Joint Chiefs of Staff (JCS[1]) in the *Joint Vision 2020* (JCS, 2000). The transformation is based on the overarching concept that U.S. forces, acting jointly and in combination with forces from other nations, will have the capability to find and defeat any enemy before that enemy poses a direct threat. A key component of this capability involves the concept of information dominance which will depend, in large part, on technological advances in the areas of advanced sensors, artificial intelligence, and network-centric command and control systems. However, it will be equally dependent on the ability of future Soldiers to use these new assets efficiently and effectively.

The transformation will most likely be dramatic, producing significant change in how the U.S. Army operates; it will be widespread, involving multiple interdependent effects across the range of Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities (DOTMLPF); and it will be continual, taking advantage of technology that will itself be advancing rapidly throughout the century. In addition, the future of U.S. Army dominance will not be as dependent as it previously was upon the Department of Defense (DOD) designing, building, and protecting unique technologies. Instead, it will most likely be built on designing, implementing, and protecting the world's best technology integration process (Carter & White, 2000). This is a different way of doing business. It is predicated on the notion that we as a nation will not be able to control the development or proliferation of new technologies in a global marketplace. Rather, we will need to become the best and fastest integrator of new technologies – into the hardware, into the software, into our doctrinal and organizational systems, and into our training and leader development processes.

A key to success in the Army's transformation is a solid process for concept development. The Army needs a means to generate, elaborate, refine, describe, test, and validate new concepts relating to doctrine, tactics, techniques, procedures, unit and team organization, job allocation, training, leader development, and other aspects of technology integration. How do we best use the total Army team – warfighter, scientist, theorist, analyst, and engineer – in the development process? Generally the Army has used two methods. The first is to have a strong theorist or analyst develop and present new concepts, that is, an Army thinker thinks and then writes. A good example of this is provided by Wass de Czege and Sinnreich (2002). While strong creative thinkers are clearly a vital part of the effort, some drawbacks are evident in the "just let thinkers think" method of concept development. The results are often very general, have not benefited from concrete attempts to implement the ideas, have not uncovered difficulties through implementation, can be hard to communicate, and do not easily benefit a team of specialized contributors working jointly. Several efforts less successful than the above-cited example could also be mentioned, resulting in "cut-and-paste" concept documents that were poorly thought out, too general, impractical, unrealistic, fragmented, disjointed and contradictory.

[1] A list of all acronyms used in this report is included in Appendix A.

A second Army method is to stand up a replica of the new system and conduct a unit exercise in simulation, such as a focused Combat Training Center (CTC) rotation or Advanced Warfighter Experiment (AWE). Such full-scale events can be effective demonstrations of moderate- to well-developed concepts but have disadvantages, especially in the earlier stages of concept formation. They are expensive and require great effort and coordination to conduct, do not allow flexible manipulation of variables, present great measurement difficulties, and lack the repetition necessary to reach well-founded conclusions. Further, the complexity of conducting the event tends to overwhelm the experimental intent.

There is a need to investigate concept development related to using methods that provide valid and reliable information while avoiding the difficulties described above. One approach is to construct an environment that transforms the scale in which situations can be presented realistically. Lickteig et al. (2002) make a strong case for developing such an environment. They describe small-scale transformation environments as "empirical venues that afford users, researchers, and developers the ability to customize tasks and conditions in order to iteratively explore and transform concepts into viable, human-centric solutions" (p. 6). They further state

> such an environment can serve as a middle ground between the situational complexity inherent in field research that resists definite conclusions, and the situational paucity of laboratory research that defies useful conclusions (Ehret, Gray, & Kirschenbaum, 2000). By design, it preserves key functional relationships based on questions of interest to evaluators or trainers, while paring away other functions that might confound answering those questions (p. 8).

A scaled environment, according to Lickteig et al. (2002), serves at least two important functions. It provides a breeding ground in which to identify and refine innovations for larger environments, and it provides a proving ground in which to assess and resolve key issues from larger environments.

The idea of the scaled environment serving as a breeding ground is consistent with the discussion included in the *Joint Operations Concept – Full Spectrum Dominance Through Joint Integration* (2003), which focuses on identification of enabling concepts or subordinate concepts that will need to be developed with sufficient detail to directly link to capabilities. Identification of such enabling concepts is a primary function of scaled transformation environments. Gold (1999) further supports this use of scaled transformation environments and warns against focusing on so-called "Superbowl" culminating events. Instead, the concept identification process should be built on a "broad-based iterative approach using a variety of tools, simulations, and venues that can lead to early discovery. Early on, searching for questions is more important than finding answers" (p. 26).

Purpose and Objectives

These thoughts and arguments about concept exploration, identification, and development come at a critical time for the U.S. Army as it engages in a major effort to transform its operations. The U. S. Army Research Institute for the Behavioral and Social Sciences (ARI), as

part of its Science and Technology Objective on *Methods and Measures of Commander-Centric Training*, conducted an analysis to describe the C4ISR functional and task requirements for FCS (Lickteig, Sanders, Durlach, Lussier, & Carnahan, 2003). Some examples of the Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) functions are: control and interpret input from a heterogeneous set of advanced sensors to mentally construct an accurate picture of enemy activity and intent (*See*), control the movement and activity of friendly manned and unmanned systems to maintain desired movement rates and formations (*Move*), distribute a variety of indirect and direct effects over a set of targets (*Fire*), assess the effectiveness of a plan and the combat instruction sets provided to robotic elements (*Rehearse*), and other functions such as *Sustain*, *Train*, *Communicate*, *Adapt*, and *Plan*. A set of tools is needed that can be used to explore selected command group functional performance issues in a methodical fashion. The tools must be flexible, that is, they must be capable of being readily tailored to respond to a wide range of conceptual constructions. The current project developed two tools – *scaled world events* and the *concept development sessions*. Scaled world events use simulation to perform a function in isolation. Concept development sessions use realistic vignettes without simulation to allow a participant to generate and evaluate ideas about future tactical issues.

The See Function

The tools were developed to address the "See" function. The application of emerging sensor capabilities will greatly affect how Army personnel see the battlefield in the near future. New technology should enhance collective, real-time common understanding of the battlefield situation over great distances and allow commanders to make rapid and accurate maneuvers in any operating environment. The enhanced capabilities will present information from robotic air and ground sensors, and from humans, using graphics and text. The deluge of information, however, will require users to 'fuse' information from these various sources into an understanding of the situation. This alone requires innovative methods of training, new concepts of presentation and succinct approaches to information presentation. Additionally, all other battlefield functions rely on input from the *See* function for successful execution; thus, concepts and methods developed relating to the *See* function will have broad effect and application within Future Forces.

An initial statement of the See function was formulated as follows:

The Command group controls and interprets information to mentally construct an accurate picture of the environment and of threat dispositions, activities, capabilities, and intent in relation to friendly dispositions, activities, capabilities, and desires.

The function was analyzed into its component tasks and activities as projected for the environment, and the tasks and activities were then examined to identify those that would be included in a synthetic environment for concept exploration. Some components of the See function that were identified are: decide what to look for, decide where to look, decide what to look with, set filters, fuse information on screen(s), review information, interpret information

(analyze and synthesize), evaluate information, track forces, verify information, share information, and identify information gaps.

Scaled-World Tool

The scaled-world tool allows participants to deploy and control various robotic sensors to perform surveillance and reconnaissance tasks in isolation, that is, separate from a full tactical context. Various types of robotic entities (aerial, mobile ground, or immobile ground), equipped with different types of sensors (e.g., visual, infrared, auditory), are represented. It supports the conduct of *scaled-world events* (SWE). Scaled-world events are preset mission scenarios in which an individual or small team performs a task or set of tasks that emulate and isolate selected components of the See function in a laboratory setting. Each scenario specifies the mission goal and the type of sensors that are available. For example, a SWE might require the participants to locate a camouflaged enemy unit. The participant can see the location of their tasked sensors on an electronic map. Simultaneously, in additional windows, they can view the sensor images and associated data. The primary purpose of the scaled-world tool is to present an accurate portrayal of the task requirements so that concept development is grounded by a realistic appreciation for the human performance difficulties associated with conducting the task. The scaled-world tool also allows researchers, by measuring and assessing the performance of participants, to draw conclusions that are applicable to future Army conditions. Issues such as human performance capabilities, training requirements, and task requirements can be investigated.

Concept-Development Tool

The concept-development tool supports the conduct of *concept-development sessions* (CDS). The notion of a CDS is that of a snapshot, or a series of snapshots, or a short presentation that places a decision-making, problem solving, or evaluation requirement on the participants. A CDS does not respond dynamically to participant input. However, CDSs can portray highly realistic situations and entities that are often very difficult to represent well in tactical simulation, for example, underground caves, car bombs, cultural factors, and situations arising from support and stability operations.

The CDSs and the concept-development tool, which are independent of the scaled-world tool, place the participant(s) in a situation in which a decision, evaluation, or other problem is posed that relates to the target functions and tasks represented in the scaled-world environment. Each CDS includes a specification or questionnaire for collecting participant thoughts, questions, conclusions, and recommendations.

The CDSs can be used in a variety of ways, including the following broad areas:

- To represent "What now?" instances, portraying a military situation and asking the participant(s) to generate and evaluate courses of action (COA).
- As "What if?" situations that explore the range of employment. For example, if the enemy used <u>x</u> method of infiltrating, how should we adjust surveillance tactics? How would the sensor plan need to be changed under <u>y</u> terrain and weather conditions?

- As acquisition-oriented human factors tools. For example, if the Army were to develop z sensor capability, how should that be employed?
- To assess the effect of infusions of new technologies by presenting realistic situations and obtaining participant reactions.

Comparison of Scaled-World and Concept-Development Tools

The scaled-world and concept-development tools complement each other in their strengths and weaknesses. An SWE represents a "scaled-down" version of a situation in which variables of interest are isolated and complicating variables are eliminated to the extent possible. In the SWE, the participant is able to manipulate sensors and perform the task in an authentic manner, allowing the participant to directly experience human performance requirements. A CDS presents a complex situation with a full range of tactical considerations. The participant is able to explore realistic situations but cannot directly interact with them. The CDS facilitates an environment in which new concepts can be explored, without being constrained by simulation implementation. It allows the researcher to define and focus emerging future issues and to accumulate the judgments of participants. Experienced together, concept development is enhanced as the case-based quality of the CDS stimulates exploration of ideas and the performance requirements of the SWE impose realistic evaluation on the feasibility of the ideas.

Scaled-World Events

Six SWEs were produced based on capabilities expected to exist in the future. Each SWE included a narrative and graphical presentation of the situation involved, the anticipated activities of the participants, and anticipated performance measures. For example, factors that are expected to affect performance in the scaled-world include threat type and size, number and types of sensors available, and rate of information being presented to participants.

The first SWE is designed at the level of a Brigade Combat Team (BCT)[2]. This event is very basic and serves the function of orienting participants to the scaled-world environment. The only variables that are manipulated are the number and types of sensors available. Participants begin the event with a terrain map showing their area of operations (AO). They receive a message from higher informing them that threat force movement in an adjacent AO was detected with the threat possibly moving into their AO. Participants attempt to locate and identify the threat forces by deploying sensors and obtaining information from sensors owned by higher or adjacent units. The threat forces consist of a stationary and camouflaged scout platoon. The event is conducted during daylight conditions. Skies are clear with no obstacles to visibility related to weather. The event concludes when the unit detects, locates, and identifies the threat force. A brief description of each SWE is shown in Table 1. Detailed descriptions of all six SWEs are in Appendix B.

[2] In the original materials, the BCT is referred to as Unit of Action (UA).

Table 1. Description of SWE tasks

SWE 1:	Detect stationary troops.
SWE 2:	Locate mobile-based biological threat.
SWE 3:	Determine enemy course of action.
SWE 4:	Determine whether shots fired are a party or a battle.
SWE 5:	Identify when a critical event occurs.
SWE 6:	Conduct battle damage assessment.

Representative screens from the scaled-world tool are shown in Figures 1 and 2. The scaled-world tool user interface is composed of four panels, as shown in Figure 1. The first is the *mode selection area* panel, which displays in the upper left portion of the screen and provides the user with the capability to manipulate the map, deploy sensors, and select sensor feeds to view. Those functions are controlled by the "Map Navigation," "New Sensors," and "Current Sensors" buttons at the top of the screen. For aerial and mobile ground sensors, users can establish a route of travel as well as a loiter pattern that the sensor will follow. The second panel, on the right, is the *map area* panel, which takes up most of the screen. The map represents a portion of Fort Hood terrain. Following sensor deployment, the map displays the sensor's location as well as its type. For example, in the center of the map area panel of Figure 1, three deployed sensors are shown. The third panel, in the lower left is referred to as the *situation area*, and contains a text description of the SWE situation. The fourth panel, lower right, is the *sensor output area* that displays messages sent by non-visual sensors (e.g., seismic, audio, biological agent). A message is displayed in the sensor output panel whenever a sensor comes within range of a target it is capable of detecting. The user can then display the sensor output for additional information including playback of audio recordings made by the sensor. For each visual sensor deployed, a new window displays the corresponding sensor image as shown in Figure 2. Three types of visual images are available: a daylight visual image, an infrared image, and a thermal image. A set of instructions (See Appendix C) provides information on loading exercises, navigating the map, and deploying and monitoring sensors.

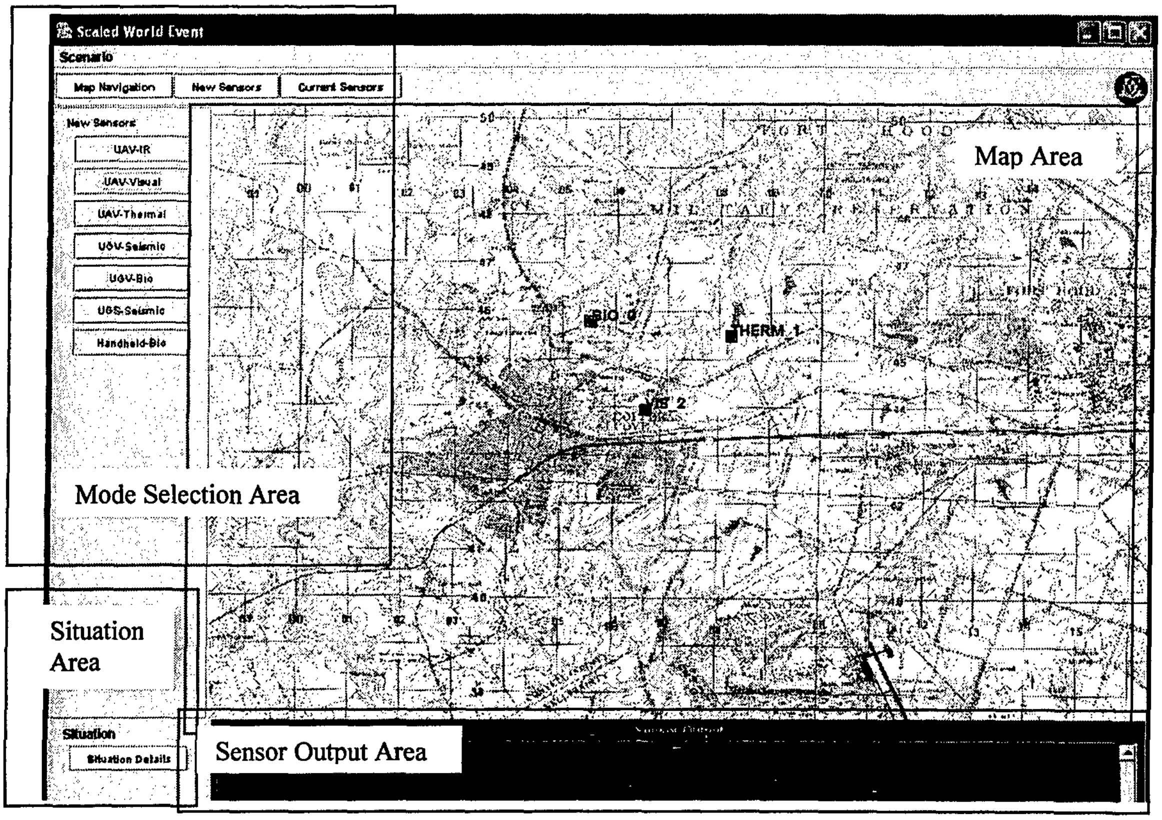

Figure 1. Scaled-world tool interface showing the user panels.

The scaled-world tool can collect limited data in a Microsoft Access® database. It can record the sensors that were deployed and whether a sensor ever came within range to detect the target. It cannot, however, record whether the user actually detected the target.

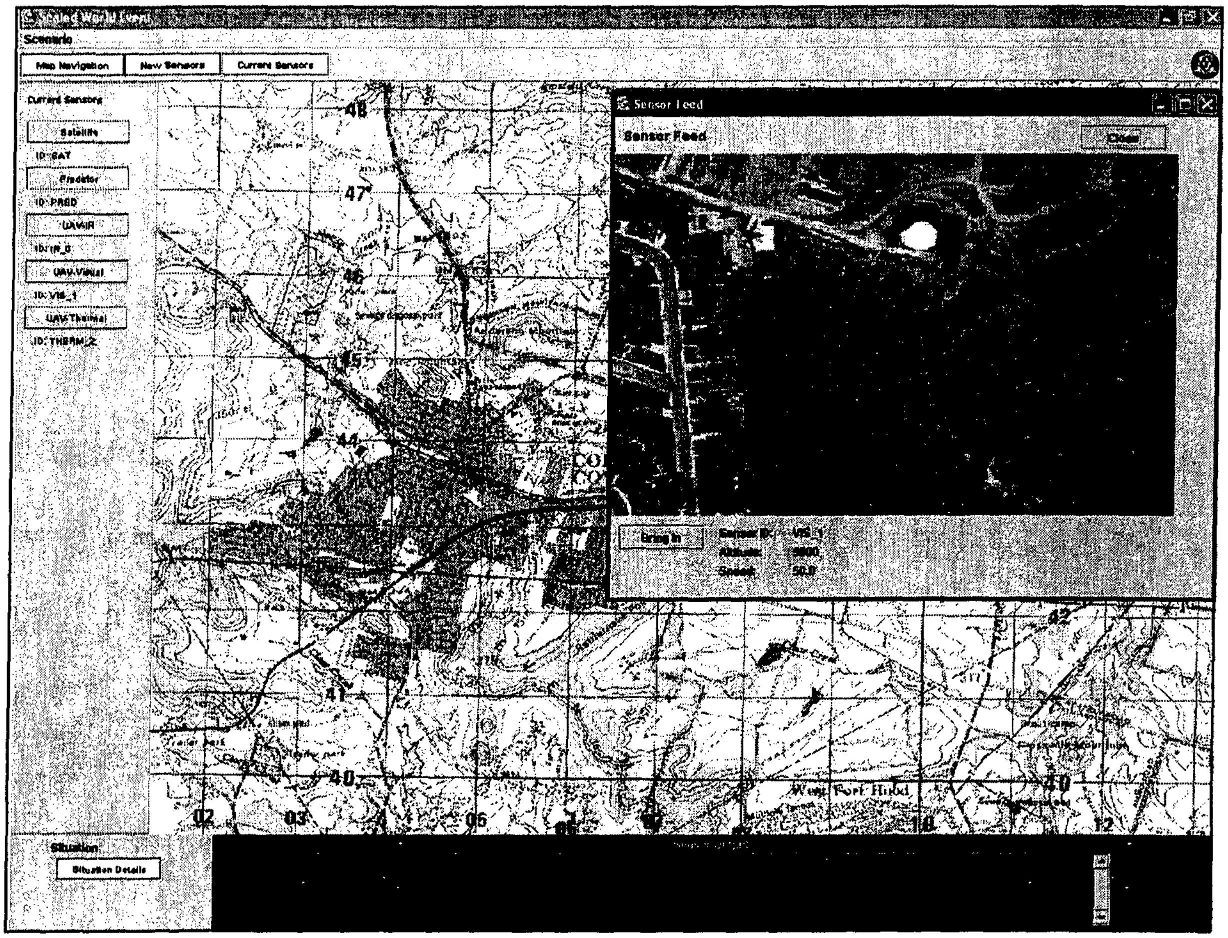

Figure 2. Scaled-world tool with sensor feed displayed.

The scaled-world tool and events were developed using Java and open-source software including:

- Gentoo Linux (Operating System).
- Netbeans 3.4 – 3.5 (Integrated Development Environment).
- OpenMap (Map Application Programming Interface).
- IzPack (Installer).
- Sun JDK 1.4.1-1.4.2 (Java Virtual Machine).
- OpenOffice (Office Suite)

In addition, terrain and visual imagery maps for Fort Hood were obtained from the National Imagery and Mapping Agency (NIMA).

Developing new events or modifying existing ones requires some level of expertise with Java. Simple modifications such as changing the characteristics of a sensor or moving the location of a target involve relatively minor changes to lines of existing code. Adding new

sensors or targets, making major modifications to an event, or creating a new event requires more extensive coding.

Concept-Development Sessions

A concept development session (CDS) is a facilitated discussion revolving around a question or issue. Each CDS presents a depiction of a situation designed to start the participants thinking about how the Army might function in the future. The goal is to generate concepts for future operations that can be used to develop ideas about tactics, techniques, and procedures (TTP), e.g., how a particular capability might best be used. Each participant is shown a problem scenario relevant to an important Army issue and asked to think through the specific situation. Then, a broader discussion is initiated to include considerations beyond the scenario presented in order to test the generality of the solutions devised for the specific scenario. A succession of participants confronting the same CDS helps to refine the concepts. In total, ten CDSs were developed.

Each session starts with an instruction screen that identifies the role the participant is to play, the tactical mission, and the goal of the session. Figure 3 shows the instruction screen for one of the CDSs.

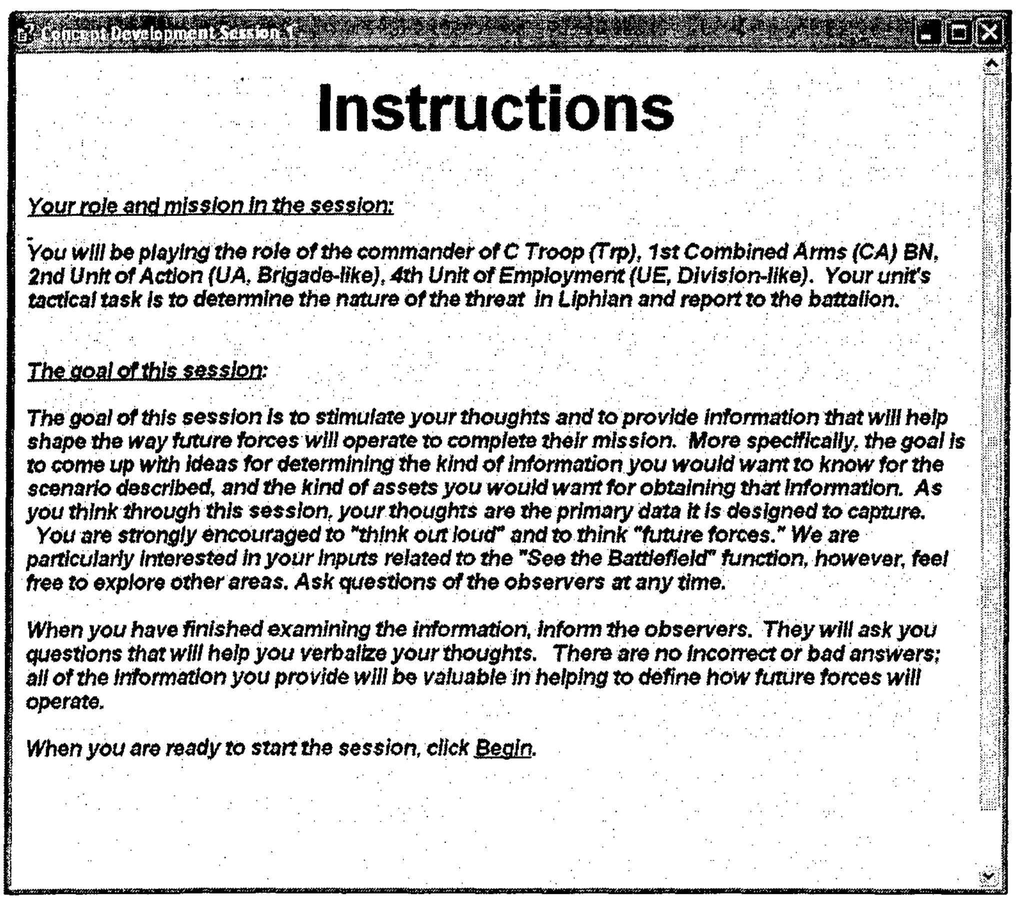

Figure 3. Typical instruction screen from a concept-development session.

When the participants click the **Begin** link, they see additional screens such as those shown in Figures 4, 5 and 6. The CDSs are designed to run in a dual-screen environment. "Hot links" on each screen allow the participant to obtain additional information. The participants are given as much time as desired to examine the information and are encouraged to "think out loud" as they study the CDS scenario. After reading the introductory page on the computer screen, the participants work through the CDS by studying and analyzing the information provided, formulating questions and plans, and indicating the need for additional information.

The first CDS, for example, presents a tactical scenario that includes a detailed written account of civilian activities in a town known to harbor threat personnel on existing blacklists. The participants view a series of photographs including groups of armed persons congregated near the town's central hall. They have access to maps along with graphic displays showing their unit task organization and additional assets available. They are told that the unit's task in this situation is to determine the nature of the threat in the town and make a report to the Battalion Commander.

The structured interview elicits responses aimed at shaping concepts and tactics, techniques, and procedures related to the situation. The specification of each CDS contains a number of pre-designed questions for the facilitator to ask. However, in each session facilitators are free to ask additional clarifying questions and follow-up on the course of participants' unique ideas. Some pre-designed questions used for the first CDS are:

1. What steps would you take to complete this task? (Follow-up and clarify as necessary)

2. What additional assets/capabilities, if any, would you liked to have had to complete this task, and how would you have employed those assets?

3. Is there information that you did not have that would have helped you complete this task? What information? How could it best be presented?

4. Is this an appropriate task for the unit indicated? Should it be a higher level task? Lower level?

Appendix D contains descriptions of all 10 CDSs.

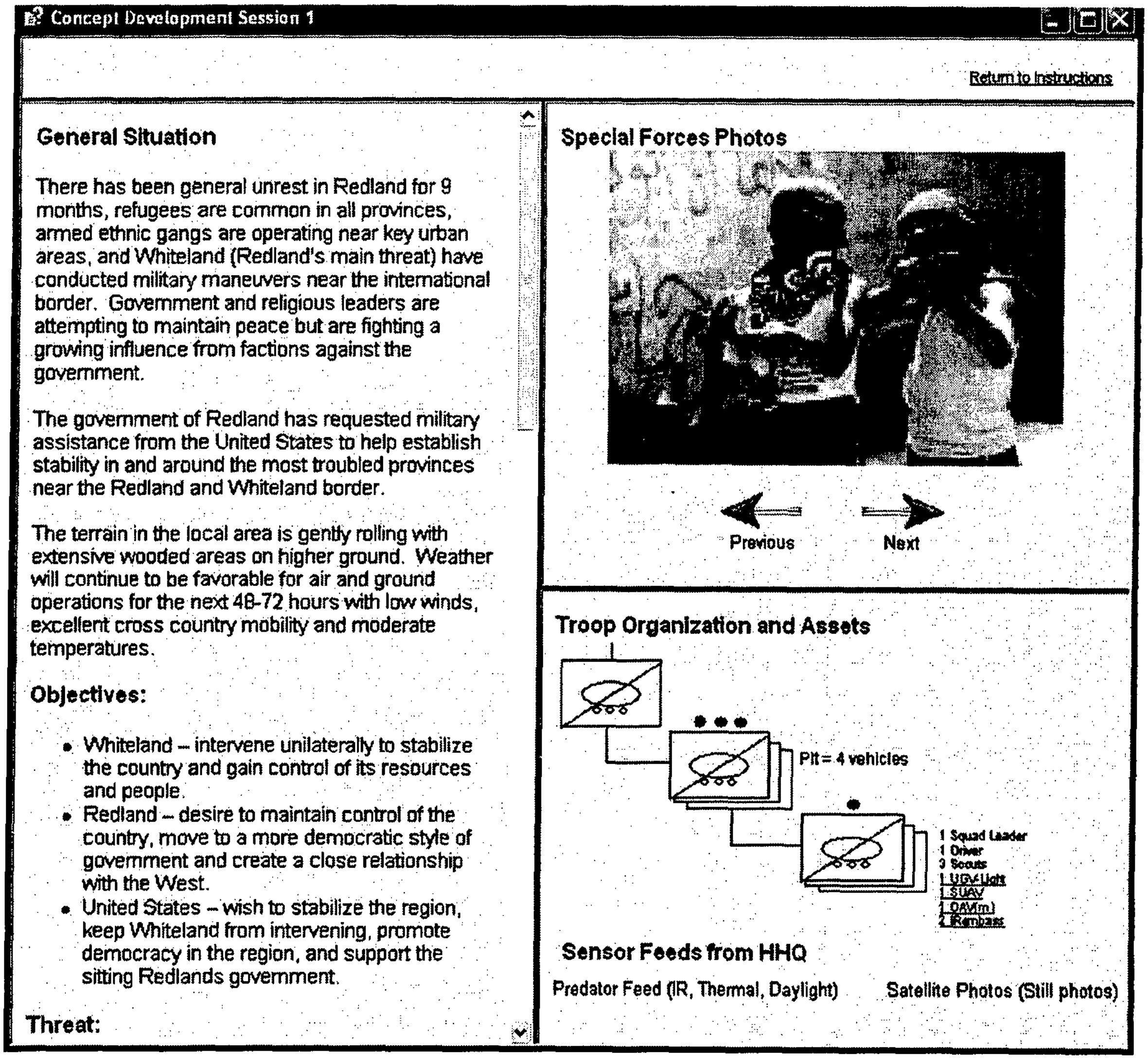

Figure 4. Typical information screen from a concept-development session with hot links to bring up additional information about the scenario.

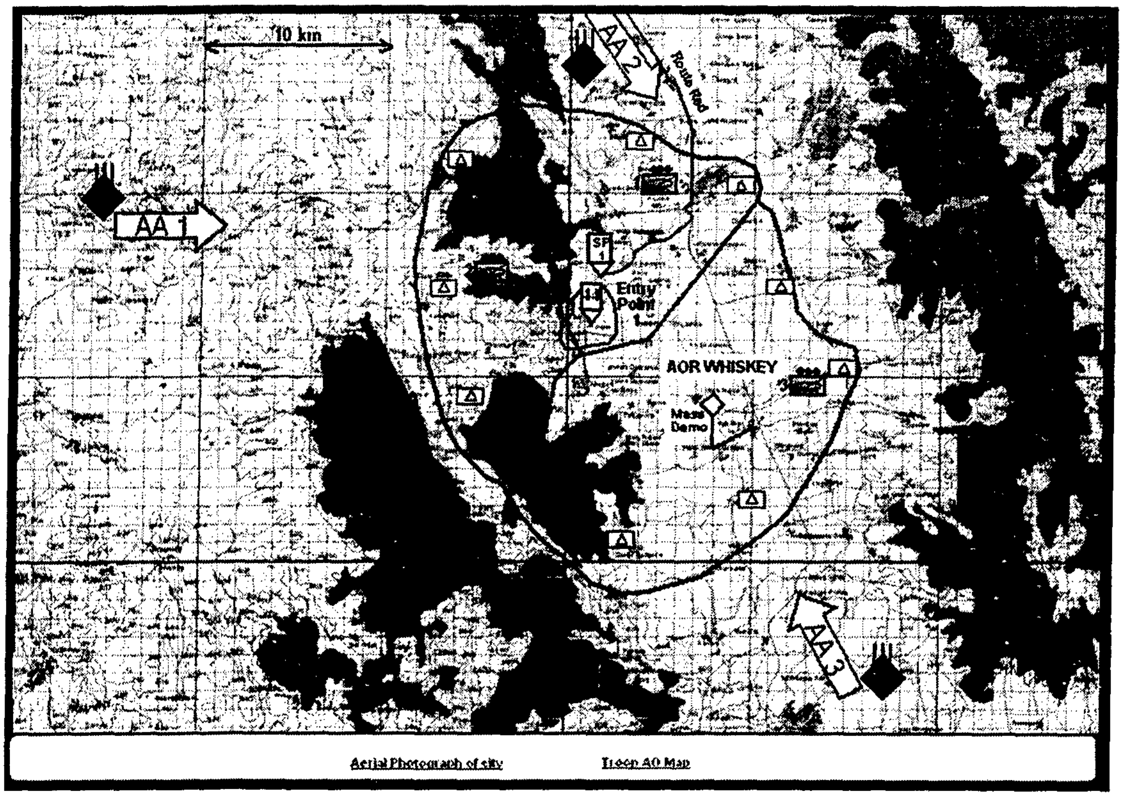

Figure 5. Typical supporting map from a concept-development session with hot links at the bottom allowing access to additional maps and pictures.

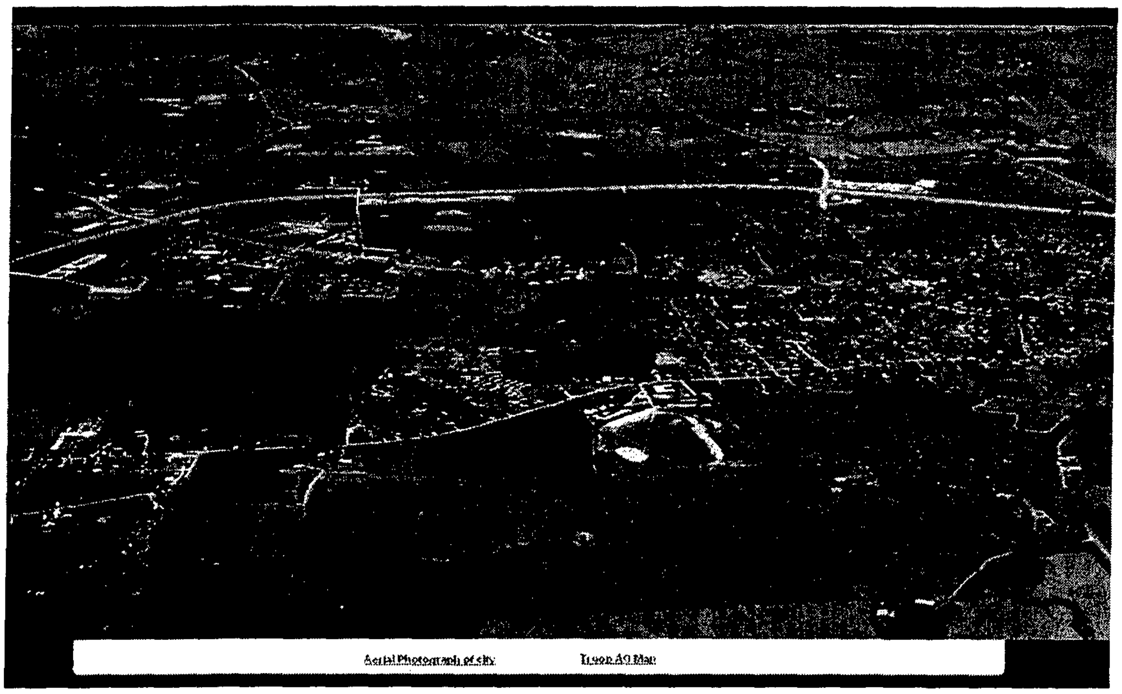

Figure 6. Aerial photo of the area of operations from a concept-development session 1 with hot links at the bottom allowing access to additional maps and pictures.

One concept for use of a CDS is as follows. Initially, one person at a time participates. After several participants, responses and process observations are used to modify the CDS to allow it to become more realistic, more focused, and to incorporate participants' ideas for additional trials. This process of refinement and presentation is repeated until, in the judgment of the researcher, no new information is being generated. At that point, final modifications are made and the CDS is presented to small groups. It is anticipated that additional information might be forthcoming from the group presentation. Again, the process is repeated until it reaches the point of diminishing returns. After analysis of data from multiple participants, a composite response to the issue is produced. Further exploration may use new CDSs or a SWE to systematically test the group solution. To facilitate administration of CDSs, an Administration Guide was developed (see Appendix E). This guide provides detailed information on presenting sessions, collecting data, modifying existing sessions, and creating new ones. (See Shadrick, Lussier, & Hinkle, 2005) for further discussion concept development in future environments.)

The concept development tool was designed to allow for modular integration of new CDSs in a fashion that allows for easy substitution of new sessions and easy modification of existing sessions. The CDSs themselves were developed using commercial off-the-shelf software including Bluesky ® RoboHTML Help™, Microsoft ® PowerPoint™, and Adobe ® Photoshop ™.

Formative Evaluation of the Concept Development Sessions

To evaluate whether the CDS concept was feasible, seven trials were conducted with nine participants. Each trial included two CDSs and was approximately two hours. The participants included one colonel, two majors, five captains, and one retired colonel. Five sessions were conducted with a single participant; two sessions were conducted with two participants. All the sessions were facilitated by a military subject-matter-expert and a research psychologist.

A number of conclusions may be drawn from the formative evaluation. Encouraging results were obtained on the ability of the CDS format to elicit participant responses. Some participants were stimulated by the CDSs to provide extremely unique, creative, and well-reasoned responses. There were, however, considerable individual differences. Some participants – even some who had spent time studying the Army's emerging future force doctrinal concepts – had difficulty critically evaluating those concepts. Some participants appeared to be able to transition into looking at the situation from the viewpoint of how things might be in the future (2015-2020) quite readily. Others required considerable, and even forceful, encouragement. Soldiers have a tendency to look at situations the way they have been trained (i.e., mission, enemy, terrain, troops, time, civilians) and they often tend to focus on a COA analysis. In a situation such as that provided in the CDS, it may require some training or encouragement to lead their thinking toward, "How else could we do things particularly if we had access to assets that don't even exist today?" On the other hand, once they did start thinking futuristically, they were (for the most part) very creative. They came up with ideas for a variety of capabilities including sensors that could "see through things," that could sense the presence of humans through exhaled gasses, and that could talk to people in their own language. If the

function of the CDSs is to stimulate individuals to think creatively and futuristically, they appear to work.

Concerning the CDS process itself, comments were generally positive as to its use as a concept development tool. Most participants either directly or indirectly indicated that the CDS tool would work. On the other hand, specific comments regarding each CDS tested were received, including some that conflicted (e.g., too much information; not enough information.)

Modifications to the Tools

This section discusses considerations for future modification, enhancement, and expansion of the SWE and the CDS tools.

In the case of the SWE, automated data collection capabilities are limited. The system can record when and where sensors were placed and whether they would ever have been capable of detecting a target. It does not actually record whether a target was detected; that would require direct observation or direct reporting. A feature could be added to the SWE that would allow the participants to indicate targets detected and their locations. The system would be able to record scenario events and certain aspects of human-computer interaction in a log file allowing the researcher to review the session in speeded up time and to pause and restart (e.g., VCR like controls). Replay of map screen and sensor information windows viewed by the player would be included. Time into the mission should be continuously displayed. The playback should also display target information on the map, annotations regarding the time of key events such as a target falling inside sensor range, time and content of operator reports, and whether these were operator initiated or prompted. Observers of the playback should be able to toggle sensor fans and UV routes on or off. Screenshots of the playback should be easily captured and saved for later analysis, e.g., analysis of the amount of area covered by sensors at a particular time.

A number of suggestions would improve the sensor behavior in the SWE. Currently, the operator can set a route for each platform. When the route is entered, the platform immediately starts on its mission and the route disappears from the map. The fact that the route disappears makes it difficult for the operator to coordinate the routes of multiple platforms. The operator should be given the ability to display routes (toggle on or off) and to display sensor fans (toggle on or off) to show area of sensor coverage. The fact that the sensor deploys immediately after the route is set makes it difficult for the operator to synchronize multiple platforms. A planning mode would allow better control of sensor missions. Also, the SWE should be upgraded to make it easier to retask sensors mid-mission (speed, altitude, and route).

In the SWE, participants can control multiple sensors and view the images from those sensors in separate windows. It can be difficult to associate the sensors on the map with their corresponding images. Information on the map display should be better linked to information in the individual sensor windows, for example, passing the mouse over a sensor window could highlight the location of the associated UV on the map. Conversely, clicking on a sensor on the map could cause some clear indication in associated sensor window, or open the sensor window if it is not already open.

Additional improvements to the SWE include adding a feature to have the sensors automatically return "home" after a set time or after completing a pattern; incorporating additional loiter patterns; and having mobile sensors begin their routes from a point of departure determined by scenario and represented on the map when the scenario is initiated.

Further suggestions for SWE improvement are converting the latitude/longitude process into a grid coordinate system more familiar to Soldiers and modifying the user interface to supply information on the coordinates for specific locations, e.g., a text window could display the coordinates of the mouse cursor. Also, the user interface should be modified to indicate the current zoom level.

The CDS, because of its inherent flexibility, did not result in such an extensive list of desirable modifications. One goal for the CDSs was not fully met – the goal of making them easily modifiable. One notion behind the approach was that as users started to identify concepts and procedures for a CDS, the CDS could be easily modified to incorporate their ideas. The current CDSs are modifiable, but only to a limited extent. As the computer-based CDSs were constructed, the developers became too tempted to add features to enhance presentation and ease of use and lost sight of the goal to make the CDSs easily modifiable. To modify the CDSs, a good working knowledge of PowerPoint and Compiled Help Files is needed. Future effort will need to be directed at how best to achieve the goal of ready modifiability, including the possibility of developing and presenting events and sessions in completely different ways.

Conclusions

This report described a project to develop tools for generating and testing concepts and ideas for situations or environments that are beyond the scope of current tactics, techniques, and procedures. It examined a process for exercising actions in a relatively controlled environment in which only a limited number of variables are allowed to have impact. It also examined another process for presenting situations or scenarios in a relatively detailed manner in order to stimulate the thinking of Soldiers and others who can provide valuable information related to the current transformation efforts underway in the U.S. Army. Both the scaled-world and the concept-development tools were formatively evaluated and, based on initial analysis, appear to be viable methods for concept identification, exploration, and testing.

As far as future research directions are concerned, several possibilities could be pursued. Primarily, the current tools could benefit from additional testing. The effectiveness and efficiency of the approach has not been empirically demonstrated. Studies that compare the tools to more conventional methods are important. If the approach can be shown to be more flexible, faster, or more direct in providing reasoned conceptual information related to systems, operations, organizations, and doctrine, then it will establish for itself a position of advantage for future developers and decision-makers.

Testing should be conducted with a variety of people. In this initial trial, we found considerable variability among the nine participants. Some participants needed considerable prodding to get them started thinking futuristically. Many participants were not particularly

aware of Future Force development directions. They are extremely involved in their day-to-day activities and have limited time to keep up with planning that is occurring for 10 to 15 years down the road. One might assume that these would be less productive participants, however, it may also be true that those most familiar with the specifics of Future Forces development efforts may be the least likely to provide useful information. Once some of the 'naïve' participants got started, some were highly capable of thinking beyond their own current assignments and view of the world. On the other hand, one of the participants directly involved with transition to the Future Force was unable to overcome the specific direction, and the specific details, of his knowledge of Future Force developments. He spent most of his time explaining the concepts described in current Army planning documents (i.e., the party line) and could not be induced to think critically about them. Although the tools were designed for concept elicitation, they may also have value in selecting people for assignments that require evaluation of future concepts.

In the current project, researchers had a great deal of latitude to select scenarios – they simply had to relate to the *See* function. In the future, the Army will want to use these tools to answer specific questions that arise from different situations. For example, as the "future thinkers" attempt to predict how individual Soldiers and units will operate, they will raise questions that are best answered empirically. The tools provide at least one approach. Research is needed to show how well the methods work when applied to specific new issues. Some answers to this question may be found in a related ongoing project in which similar tools and methods are being used to develop training for a task that lacks recognized experts – interagency crisis action planning and execution.

How can we best use the total Army team – warfighter, scientist, theorist, analyst, and engineer – in the concept development process? The tools described here are a preliminary step in answering that question. They represent something between simple "brainstorming" and full-blown simulation – providing structure and control without requiring exorbitant resource commitments. What other effective tools fall somewhere in between those two extremes? What is the best way to use the SWE, CDS, and other new tools in the concept discovery, development, and testing process? These remain open questions and are the subject of continuing U.S. Army Research Institute for the Behavioral and Social Sciences research.

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Appendix A

List of Acronyms

AO	Area of Operation
ARI	U.S. Army Research Institute for the Behavioral and Social Sciences
AWE	Advanced Warfighter Experiment
BCT	Brigade Combat Team
BDA	Battle Damage Assessment
Bde	Brigade
Bn	Battalion
CA	Combat Assessment
CAB	Combat Aviation Brigade
CCIR	Commander's Critical Information Requirement
CDS	Concept-Development Sessions
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance
COA	Course of Action
COP	Common Operational Picture
CTC	Combat Training Center
DOD	Department of Defense
DOTMLPF	Doctrine, Organization, Training, Material, Leadership and Education, Personnel, and Facilities (DOTMLPF)
FCS	Future Combat Systems
FE	Formative Evaluation
GCM	Graphic Control Measures
HQ	Headquarters
IPB	Intelligence Preparation of the Battlespace
ISG	Intuitive Summary Graphics
ISR	Intelligence, Surveillance, and Reconnaissance
JCS	Joint Chiefs of Staff
MI	Military Intelligence
MTW	Major Theater War
NIMA	National Imagery and Mapping Agency

O&O	Operational and Organizational
ORD	Operational Requirements Document
RSTA	Reconnaissance, Surveillance, and Target Acquisition
SME	Subject Matter Expert
SSC	Small Scale Contingency
SWE	Scaled-World Events
TTP	Tactics, Techniques, and Procedures
UA	Unit of Action
UAMBL	Unit of Action Maneuver Battle Lab
UAV	Unmanned Aerial Vehicle
UE	Unit of Employment
UGV	Unmanned Ground Vehicle
WMD	Weapons of Mass Destruction

Appendix B

Scaled-World Event Specifications

SCALED-WORLD EVENT 1 SPECIFICATION

Title	**Detect and identify threat forces**
General description	In this event, participants attempt to locate and identify threat forces within their area of operations (AO) by deploying sensors and/or obtaining information from sensors owned by higher or adjacent units. The event is triggered by a message from higher stating that reports of possible threat forces in their AO have been received. This event is for the Unit of Action (UA) command group (with two members – the commander and the intelligence, surveillance, and reconnaissance [ISR] Coordinator – participating). This event is very basic and serves the function of orienting participants to the scaled-world environment as well as providing a research opportunity. The only variables that are manipulated in this event are the number and types of organic sensors available to the unit, and the numbers and types of non-organic sensors from which the unit can obtain information. This event measures performance on the dependent variables as a function of manipulating the independent variables; however, it also examines process data. That is, it records and analyzes the specific activities, decisions, and other process data to the extent possible in order to provide a more complete understanding of the measured relationships between the independent and dependent variables. Participants begin the event with a terrain map showing their AO. They receive a message informing them that threat force movement in an adjacent AO was detected with the threat possibly moving into their AO. This provides the cue to conduct electronic surveillance to detect and identify the possible threat forces. Threat forces consist of a scout platoon. They are stationary and camouflaged. The event is conducted during daylight conditions. Skies are clear with no obstacles to visibility related to weather. The event concludes when the unit detects, locates and identifies the threat force.
Tasks	▪ Decide what to look for. ▪ Decide where to look. ▪ Decide what to look with. ▪ Review information. ▪ Interpret information. ▪ Evaluate information.

Independent variables	▪ Number and type of organic sensors. ▪ Number and type of non-organic sensors.
Dependent variables	▪ Time to detect threat forces. ▪ Accuracy of detection and identification.
Process data	▪ Observations/data of participant performance/actions during completion of the event, collected automatically. ▪ Participant responses/reactions, collected during post-event debriefing.
Measurement plan	The two dependent variables (time required to locate and identify threat forces and accuracy of location and identification) are measured by observation. Two observers monitor each event and record start-time and end-time. The observers also record the accuracy of the location and identification of the threat as either correct or incorrect. These measures provide the primary basis for comparing the effects of manipulating the independent variables of types and numbers of organic and non-organic sensors available to the participants. In addition, the scaled-world environment is constructed to collect this data to the extent possible. In addition to these measures, the complete event session is videotaped in order to capture process data. The observers and the scaled-world environment also record process data as the event proceeds. They record the steps/actions the participants used in deploying sensors, in processing information received from the sensors, data received from the sensors, decisions made, interactions between participants, and other process information as appropriate. The observers employ an observation checklist. However, it will not be used restrictively. The tapes of the session along with the data collected by the scaled-world environment are used to verify/supplement observer recorded process data. Following the event, the participants are debriefed by the observers in a structured interview setting. The observers use a structured interview form for conducting the debrief session and for recording responses. These sessions are also videotaped to allow verification of observer-recorded data.
Data analysis	Primary data analysis consists of (1) comparing the time to locate and identify the threat force as a function of numbers and types of organic and non-organic sensors; and (2) comparing the accuracy of location and identification of the threat force as a function of numbers and types of organic and non-organic sensors. Secondary data analysis consists of performing qualitative analysis of the process data recorded during the event and post-event debriefing. This analysis is conducted to provide further explanation of results observed in the primary analysis.

SCALED-WORLD EVENT 2 SPECIFICATION

Title	Locate a mobile based biological weapon threat
General description	The enemy has a biological weapon of mass destruction (WMD) that is contained on a mobile platform (probably a medium to large truck). The objective of the event is to locate the truck and the weapon. The unit has two types of sensors that are capable of detecting biological weapons: a fully robotic ground-based sensor capable of detecting a biological weapon from a distance less than 100 meters; and a manned sensor capable of detecting a biological weapon from a distance less than 10 meters. Both sensors have error rates of 25% false positives and 1% false negatives. The unit has organic ground and air sensors capable of providing visual (video, infrared, radar) images and access to information from non-organic sensors. They also have ground sensors capable of providing audio and seismic data. This event is for the UA command group (with two members – the commander and the ISR Coordinator – participating). This event is process oriented. The primary interest is in observing the strategy that the group employs in locating the biological weapon. Because of the limited range of the biological weapons sensors, the group will need to develop a strategy for using its other reconnaissance and surveillance assets to isolate probable locations of the platform containing the biological weapon. Participants begin the event with a terrain map showing their AO. They receive a message informing them that intelligence reports indicate that enemy forces are thought to have a biological weapon which has been placed on an unknown mobile platform. The location of the platform and weapon is unknown; however, its detection and identification are highest priority. The event is conducted during daylight conditions. Skies are clear with no obstacles to visibility related to weather. The event concludes when the biological weapon has been located.
Tasks	▪ Decide where to look. ▪ Decide what to look with. ▪ Fuse information on screens. ▪ Review information. ▪ Interpret information. ▪ Evaluate information. ▪ Verify information.
Independent variables	None (Note: Future variations of this event could include manipulation of variables such as weather conditions, time of day/night, range of biological-sensors)

Dependent variables	▪ Time to locate the biological weapon. ▪ Accuracy of detection.
Process data	▪ Observations/data of participant performance/actions during completion of the event, collected automatically. ▪ Participant responses/reactions, collected during post-event debriefing.
Measurement plan	The two dependent variables (time required to locate and accuracy of detection) are measured by observation. Two observers monitor each event and record start-time and end-time. The observers also record the accuracy of the participants' location and identification as either correct or incorrect. In addition, the scaled-world environment is constructed to collect this data to the extent possible. In addition to these measures, the complete event session is videotaped in order to capture process data which, as stated above, are the date of primary interest for this event. The observers also record process data as the event proceeds. They record the steps/actions the participants used in deploying sensors, in processing information received from the sensors, data received from the sensors, decisions made, interactions between participants, and other process information as appropriate. The observers employ an observation checklist; however, it is not to be used restrictively. The tapes of the session along with the data collected by the scaled-world environment are used to verify/supplement observer recorded process data. Following the event, the participants are debriefed by the observers in a structured interview setting. The observers use a structured interview form for conducting the debrief session and for recording responses. These sessions are also videotaped to allow verification of observer-recorded data.
Data analysis	Primary data analysis consists of performing qualitative analysis of the process data recorded during the event and post-event debriefing. This analysis attempts to identify factors in the participants performance related to effective and ineffective results (as indicated by successful location of the biological weapon in a timely manner). The analysis also seeks to identify factors/variables which would have facilitated performance by examining results obtained from the participant debriefing session.

SCALED-WORLD EVENT 3 SPECIFICATION

Title	**What course of action is the enemy taking?**
General description	The unit has received a message from UA Battalion showing likely courses of action (COA) the enemy may take. A number of these COAs fall within the unit's AO. The unit is directed to initiate reconnaissance and surveillance to determine which COAs the enemy is actually taking and to report the information to Battalion. This event is for the UA command group (with two members – the commander and the ISR Coordinator – participating). This event measures performance on the dependent variables as a function of manipulating the independent variables; however, it also examines process data. That is, it records and analyzes the specific activities, decisions, and other process data to the extent possible in order to provide a more complete understanding of the measured relationships between the independent and dependent variables. This event provides an opportunity to exercise more of the "SEE" tasks than does the "Detect and identify threat forces" event, and also introduces additional dependent and independent variables. Independent variables include numbers and types of sensors, numbers of COAs lying within the Company's AO, number of COAs the enemy actually follows, and unanticipated COAs. Dependent variables include time required to determine enemy COAs and accuracy of determining enemy COAs. Participants begin the event with a terrain map showing their AO. They receive a message from Battalion Headquarters (HQ) detailing selected intelligence preparation of the battlespace (IPB) products including potential enemy COAs and directing them to conduct reconnaissance and surveillance to identify which COAs the enemy is following. The event is conducted during daylight conditions. Skies are clear with no obstacles to visibility related to weather. The event concludes when the Company command group reports enemy COA(s) to Battalion HQ.

Tasks	▪ Decide where to look. ▪ Decide what to look with. ▪ Fuse information on screens. ▪ Review information. ▪ Interpret information. ▪ Evaluate information. ▪ Verify information. ▪ Track forces. ▪ Share information.
Independent variables	▪ Number and type of organic sensors. ▪ Number and type of non-organic sensors. ▪ Number of COAs lying within the Company's AO. ▪ Number of COAs the enemy follows. ▪ Unanticipated COAs the enemy follows.
Dependent variables	▪ Time to identify enemy COA after enemy initiates activity. ▪ Accuracy of identification. ▪ Timeliness and accuracy of reporting to Battalion HQ.
Process data	▪ Observations/data of participant performance/actions during completion of the event, collected automatically. ▪ Participant responses/reactions, collected during post-event debriefing.
Measurement plan	The dependent variables are measured by observation. Two observers monitor each event and record start-time, time each enemy COA was identified, time reports were made to Battalion HQ, and end-time. The observers also record the accuracy of the participants' identification as either correct or incorrect. In addition, the scaled-world environment is constructed to collect this data to the extent possible. In addition to these measures, the complete event session is videotaped in order to capture process data. The observers also record process data as the event proceeds. They record the steps/actions the participants used in deploying sensors, in processing information received from the sensors, data received from the sensors, decisions made, interactions between participants, communication with Battalion HQ, and other process information as appropriate. The observers employ an observation checklist; however, it is not used restrictively. The tapes of the session along with the data collected by the scaled-world environment are used to verify and supplement observer recorded process data. Following the event, the participants are debriefed by the observers in a structured interview setting. The observers use a structured interview form for conducting the debrief session and for recording responses. These sessions are also videotaped to allow verification of observer-recorded data.

Data analysis	Primary data analysis consists of (1) comparing the accuracy of COA identification (i.e., the COA(s) the enemy actually follows) as a function of numbers and types of organic and non-organic sensors, numbers of COAs falling within the AO, number of COAs actually followed, and unanticipated COA(s) followed; (2) comparing the time required to identify COA(s) followed as a function of these variables; and (3) accuracy and timeliness of reporting to Battalion HQ as a function of these variables. Secondary data analysis consists of qualitative analysis of the process data recorded during the event and post-event debriefing. This analysis is conducted to provide further explanation of results observed in the primary analysis.

SCALED-WORLD EVENT 4 SPECIFICATION

Title	Party or battle?
General description	U.S. forces are in Alkastan as part of an allied peace keeping operation. Alkastan has been engaged in a civil war based, for the most part, upon ethnic divisions within the country. Neither faction is particularly friendly toward allied forces, and there continue to be numerous skirmishes between factions. Allied forces routinely conduct reconnaissance and surveillance using air and ground assets, both manned and robotic, and on occasion, these forces come under fire. On the other hand, there have been two recent incidents in which allied forces incorrectly identified actions of civilian populations as threatening, firing on them and producing casualties. Allied forces have concluded that, from a distance, civilian celebrations are difficult to distinguish from threatening actions since both involve small-arms fire, and a lot of loud vocalizations. In the present instance, a reconnaissance, surveillance, and target acquisition (RSTA) troop has been cued by a brigade sensor to investigate a group of about 100 people shouting and firing weapons. The troop commander must determine whether this represents a threat to his unit. This event is for the troop commander. The troop has sensors and scouts capable of sending live video to the troop commander as well as to higher. It also has organic unmanned aerial vehicles (UAVs) capable of providing video and infrared images. It has unmanned ground vehicles (UGVs) that can provide seismic information. The unit leader has no access to any additional sensor information. Two independent variables are manipulated in this event: the time of day (daylight or dark) and the threat level (no threat – it's a celebration; threat to other ethnic group; threat to the unit). The dependent variable is identification (correct or incorrect) of the threat level. This event measures performance on the dependent variable as a function of manipulating the independent variables; however, it also examines process data. That is, it records and analyzes the specific activities, decisions, and other process data to the extent possible in order to provide a more complete understanding of the measured relationships between the independent and dependent variables. Participants begin the event upon being cued by sensor feed. The troop commander must determine where the fire is originating and the probable intent of the group initiating fire.

Tasks	▪ Position sensors/soldiers. ▪ Review information. ▪ Interpret information. ▪ Evaluate information. ▪ Verify information. ▪ Share information.
Independent variables	▪ Time of day (daylight or night). ▪ Threat condition (no threat; threat against another force; threat against the platoon).
Dependent variable	▪ Accuracy of identification of threat condition.
Process data	▪ Observations/data of participant performance/actions during completion of the event, collected automatically. ▪ Participant responses/reactions, collected during post-event debriefing.
Measurement plan	The dependent variable is measured by observation. Two observers monitor each event and record the threat condition identified. The observers also record the accuracy of the participants' identification as either correct or incorrect. In addition, the scaled-world environment is constructed to collect data to the extent possible. In addition to these measures, the complete event session is videotaped in order to capture process data. The observers also record process data as the event proceeds. They record the steps/actions the participants used in deploying personnel and sensors, in processing information received from the personnel and sensors, data received from the personnel and sensors, decisions made, interactions between participants, communication with higher HQ, and other process information as appropriate. The observers employ an observation checklist; however, it is not used restrictively. The tapes of the session along with the data collected by the scaled-world environment are used to verify/supplement observer recorded process data. Following the event, the participants are debriefed by the observers in a structured interview setting. The observers use a structured interview form for conducting the debrief session and for recording responses. These sessions are also videotaped to allow verification of observer-recorded data.
Data analysis	Primary data analysis consists of comparing the accuracy of the threat condition identification as a function of the actual threat condition and time of day. Secondary data analysis consists of performing qualitative analysis of the process data recorded during the event and post-event debriefing. This analysis is conducted to provide further explanation of results observed in the primary analysis.

SCALED-WORLD EVENT 5 SPECIFICATION

Title	**Sensor overload?**
General description	The commander of the Military Intelligence (MI) Company has been directed by Brigade HQ to monitor sensor feeds and report when critical event XX occurs (e.g., a column of heavy vehicles passes a specific location.) The commander has feeds from sensors that detect and feed video, infrared, and seismic signals. The task becomes more difficult as the number and types of available feeds increases, and as the number of events the commander is monitoring for increases. This event is for the MI Company commander. This event is designed to examine the processing capabilities of an observer as a function of the number and type of information streams being observed, and of the number of targets the observer is attempting to detect. Three independent variables are manipulated in this event: the number of sensor feeds being monitored; the type of sensor feeds being monitored; and the number of critical events the participant is monitoring for. Two dependent variables are measured: was the critical event detected; and how long after it first appeared in a sensor feed was the event detected. This event measures performance on the dependent variables as a function of manipulating the independent variables; however, it also examines process data. That is, it records and analyzes the specific activities, decisions, and other process data to the extent possible in order to provide a more complete understanding of the measured relationships between the independent and dependent variables. Because of the likelihood of data confounding if a repeated measures design were employed, each participant participates in a single trial. Participants begin the event upon receiving an order from Brigade (Bde) HQ to observe sensor feeds 1 – n for the occurrence of critical events a - x. The number of sensor feeds varies from 1 to 9. The type varies among video, infrared, and seismic. The display size for each sensor remains constant regardless of the number of sensor feeds employed. The number of critical events varies from 1 to 3. (Note: the participant does not control sensor placement or type; he is monitoring sensor feeds. In addition, in situations where there is a single sensor feed, the critical event will be one appropriate to the type of sensor being employed). As soon as a critical event is detected, the participant reports to Battalion (Bn) HQ via radio contact.
Tasks	▪ Filter sensor feeds. ▪ Review information. ▪ Interpret information. ▪ Evaluate information. ▪ Verify information. ▪ Share information.

Independent variables	▪ Number of sensor feeds. ▪ Type of sensor feeds. ▪ Number of critical events.
Dependent variable	▪ Accuracy of critical event detection. ▪ Time required to detect critical event.
Process data	▪ Observations/data of participant performance/actions during completion of the event, collected automatically. ▪ Participant responses/reactions, collected during post-event debriefing.
Measurement plan	The dependent variables are measured by observation. Two observers monitor each event and record when the sensor feed indicating the occurrence of a critical event occurred. They also record if, and when, the participant observed the critical event and made his report to HQ. This process is repeated for each critical event included. In addition to these measures, the complete event session is videotaped in order to capture process data. The observers also record process data as the event proceeds. They record the steps/actions the participants used in deploying personnel and sensors, in processing information received from the personnel and sensors, data received from the personnel and sensors, decisions made, interactions between participants, communication with Company HQ, and other process information as appropriate. The observers employ an observation checklist; however, it will not be used restrictively. The tapes of the session along with the data collected by the scaled-world environment are used to verify/supplement observer recorded process data. Following the event, the participants are debriefed by the observers in a structured interview setting. The observers use a structured interview form for conducting the debrief session and for recording responses. These sessions are also be videotaped to allow verification of observer-recorded data.
Data analysis	Primary data analysis consists of comparing the accuracy and latency of the critical event detection across participants as a function of the number of sensor feeds, type of sensor feeds, and number of critical events. Secondary data analysis consists of performing qualitative analysis of the process data recorded during the event and post-event debriefing. This analysis is conducted to provide further explanation of results observed in the primary analysis.

SCALED-WORLD EVENT 6 SPECIFICATION

Title	**Determine battle damage assessment**
General description	Friendly forces have conducted an air assault in A Company's AO. Aircraft will continue to be in a position to conduct additional strikes based on battle damage assessment (BDA) completed by A company. This event is for the UA command group (with two members – the commander and the ISR Coordinator – participating). This event is process oriented. The primary interest is in observing the strategy that the group employs in assessing the damage produced by the air strikes. Because the time to conduct BDA is limited, the group needs to develop a strategy for using its sensor assets as efficiently as possible. Participants begin the event with a terrain map showing their AO. They receive a message directing them to assess damage produced by air strikes at three locations in their AO. They are given a time limit to report BDA results based on how long the attack aircraft will be in position to initiate another attack. The event is conducted during daylight conditions. Skies are clear with no obstacles to visibility related to weather. The event concludes with the BDA report.
Tasks	▪ Decide what to look with. ▪ Fuse information on screens. ▪ Review information. ▪ Interpret information. ▪ Evaluate information. ▪ Verify information.
Independent variables	▪ Time attack aircraft will be in position to initiate a second attack (15 or 30 minutes).
Dependent variable	▪ Accuracy of BDA. ▪ Time to conduct BDA.
Process data	▪ Observations/data of participant performance/actions during completion of the event, collected automatically. ▪ Participant responses/reactions, collected during post-event debriefing.

Measurement plan	The two dependent variables (accuracy of BDA and time to conduct BDA) are measured by observation. Two observers monitor each event and record start-time and end-time. The observers also record the accuracy of the participants' assessment as either correct or incorrect. In addition, the scaled-world environment is constructed to collect this data to the extent possible. In addition to these measures, the complete event session is videotaped in order to capture process data which, as stated above, are the date of primary interest for this event. The observers also record process data as the event proceeds. They record the steps/actions the participants used in deploying sensors, in processing information received from the sensors, data received from the sensors, decisions made, interactions between participants, and other process information as appropriate. The observers employ an observation checklist; however, it will not be used restrictively. The tapes of the session along with the data collected by the scaled-world environment are used to verify/supplement observer recorded process data. Following the event, the participants are debriefed by the observers in a structured interview setting. The observers use a structured interview form for conducting the debrief session and for recording responses. These sessions are also videotaped to allow verification of observer-recorded data.
Data analysis	Primary data analysis consists of qualitative analysis of the process data recorded during the event and post-event debriefing. This analysis attempts to identify factors in the participants performance related to effective and ineffective results (as indicated by successful location of the biological weapon in a timely manner). The analysis also seeks to identify factors/variables which would have facilitated performance by examining results obtained from the participant debriefing session.

Appendix C

Scaled-World Environment
User Instructions

Scaled-World Environment

User Instructions

I. Loading A Scenario

1. After deciding which scenario you will execute, click the **left mouse button** on the Scenario menu and move the mouse over the selected scenario. As shown in Figure C-1. Next select the desired version of the scenario from the submenu, as shown in Figure C-2.

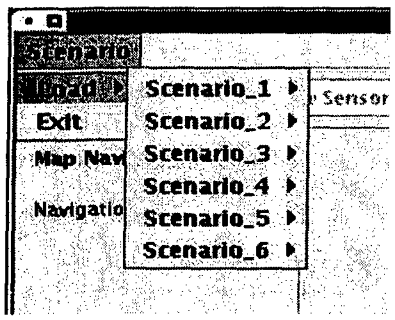

Figure C-1. Scenario selection dropdown menu.

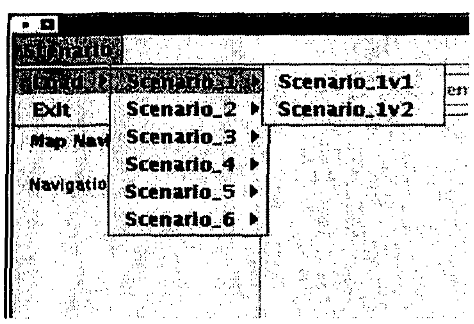

Figure C-2. Scenario version dropdown menu.

2. When the scenario is loaded, a description of the scenario situation is displayed. This description provides details of the current situation as well as a list of the sensors you have available. After reading the situation, you may close the window by clicking the **Close** button. At any time during the scenario, you can view the details again by clicking on **Situation Details** in the lower left hand corner of the screen. See Figure C-3

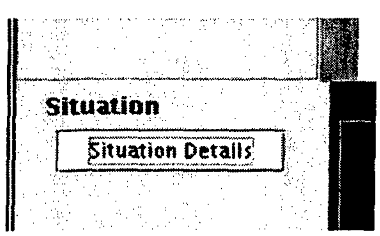

Figure C-3. Situation details button.

II. Screen Layout – When the scenario loads, your screen will appear similar to the one shown in Figure C-4. The screen includes four main panels:

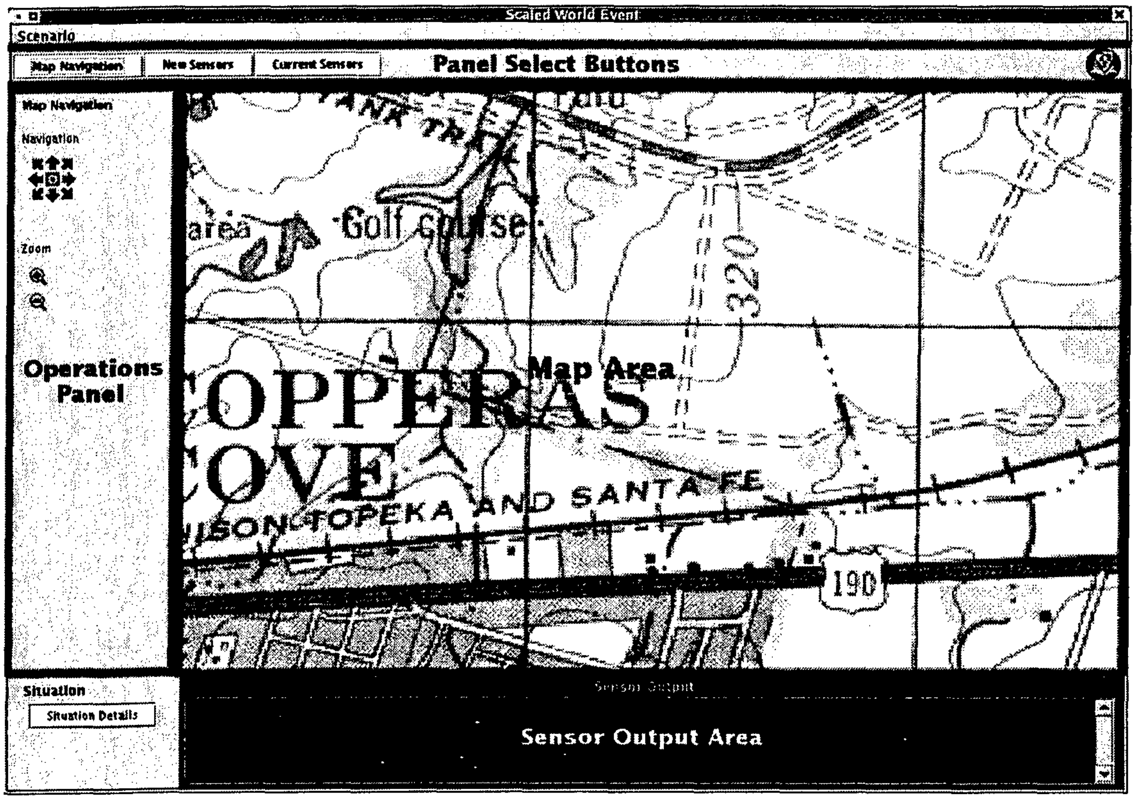

Figure C-4. Initial scaled-world tool screen layout.

1. Operations Panel – on the left side of the screen; changes depending upon which panel is selected (see below). The operations panel is used to interact with and obtain information from the map, deploy sensors, and select sensors to view.

2. Panel Select Buttons – across the top of the screen; control the current operation panel.

3. Map Area – the map area displays the current map view, along with any sensors that might be within the displayed region.

4. Sensor Output Area – across the bottom of the screen; displays text messages sent by deployed sensors.

III. Navigating the Map

1. The navigation panel is the default panel displayed in the Operations Panel. If you have selected the **New Sensors** or **Current Sensors** panel, you can return to the navigation panel by selecting the **Map Navigation** button.

2. Map navigation consists of two functions: Pan and Zoom.

   - The pan buttons are the directional arrows in the upper part of the Navigation panel. To move the map, select the appropriate arrow. The amount of movement depends on the current area of the displayed map. In the center of the arrows is a square block. Clicking this block will return the center of the map to the center of the screen.

   - The zoom buttons are the magnifying glass images with the plus (+) and minus (-) signs. When clicked, the plus image zooms in (displays a smaller area), and the minus image zooms out (displays a larger area).

IV. Deploying Sensors

Sensors are deployed using the **New Sensors** panel. Deployment involves two functions: selecting the type of sensor you want to deploy; and laying down (i.e., drawing) the sensor's route of travel. However, before describing these functions, you need to know some basic sensor information.

1. Basic Sensor Platform Information

   There are three main types of sensor platforms: Aerial, Ground, and Stationary. Each platform is capable of carrying a variety of sensor types. All sensor identification codes start with "U" indicating that they are unmanned.

   - Aerial – air based platforms for which you can set a speed and altitude. These sensors are identified by the "AV" in the sensor code (i.e., UAV).

   - Ground – land based platforms for which you can set a speed. These sensors are identified by the "GV" in the sensor code (i.e., UGV).

   - Stationary – land based platforms that have no movement. These sensors are identified by the "GS" in the sensor code (i.e., UGS).

2. Basic Sensor Types

   There are four classes of sensors: visual, audio, seismic, and biological agent. In general, aerial platforms will carry visual sensors; land based platforms will carry audio, seismic, and biological agent. There is also a hand-held biological agent sensor.

   - Visual – sensors that display a visual image. There are three types of visual sensors: video (displays a basic daylight image), infrared (displays image filtered through infrared filters), and thermal (displays visual image of heat emissions given off by objects).

- Audio – sensors that detect and record sounds.
- Seismic – sensors that detect ground vibrations such as those produced by tracked vehicles, trucks, etc.
- Biological agent – sensors that detect the presence of biological agents such as anthrax.

3. Selecting a Sensor for Deployment

   - When you select the **NewSensors** panel, it will display a list of the sensor types (platform and sensor) that are available for the scenario. Click on the sensor you wish to deploy.
   - When you select a UAV or UGV type sensor, a sensor properties box shown in Figure C-5, lets you set the speed and (for UAVs) altitude of the sensor. After setting the sensor parameters, Click the **Done** button. You can now lay down the route (see below).
   - If you select a stationary sensor, you will not see a sensor control box. Stationary sensors do not move and, therefore, all you need to do is place them.

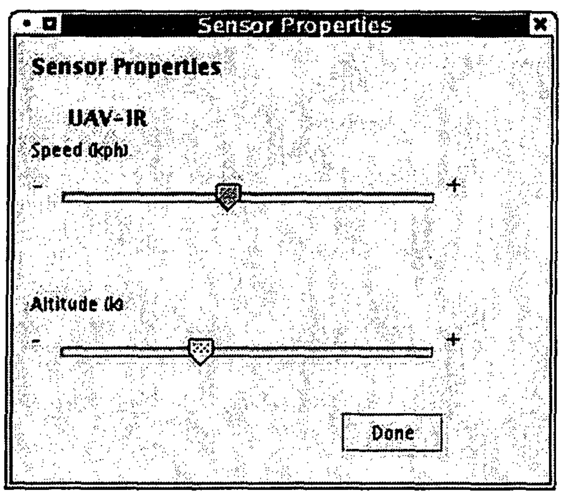

Figure C-5. Sensor properties control.

4. Laying down the sensor's route of travel.

   - If you have selected a UAV or UGV for deployment, you must specify its route of travel after you have specified its properties. You will do this on the map itself by specifying a starting point, interim waypoints, and a final loitering pattern.
   - To select a starting point, move the mouse pointer to the desired location on the map and **Left Click**.
   - Move the mouse pointer to the first desired waypoint and **Left Click.**
   - Repeat step 3 for each desired waypoint.

- You can now specify a circular loitering pattern (i.e., a pattern the sensor will continue to move in for the remainder of the scenario or until you recall it.) Move the mouse pointer to the location of the center of the loitering pattern and **Right Click**.
- Move the mouse pointer and a circular track will appear on the map as shown in Figure C-6. When you have laid down the desired loitering pattern, **Left Click**. A green square will appear on the map with an appropriate sensor ID.
- If you want to cancel a sensor before you finish its deployment, just **Double Click** the left mouse button in the Map Area.

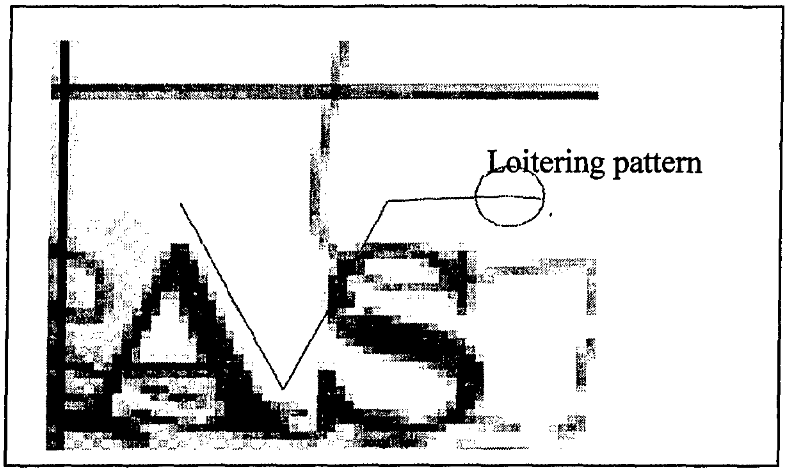

Figure C-6. Loitering sensor.

V. Viewing Sensor Output

When you select the **Current Sensors** panel, you will be able to access all of the sensors you have deployed in addition to any other sensor inputs you may have access to. For example, you may be able to access the feed from a satellite controlled by a Unit of Employment (UE). Each of the sensor types has its own output. In addition, a sensor may display a text message in the **Sensor Output** panel. You can scroll through all of the messages that have been sent by the various sensors during the course of the scenario. There are three types of sensor output: audible, visual, and textual. Different scenarios require the use of different types of sensors. Each is available in the appropriate scenario.

1. Seismic sensors will alert the user of activity via a text message in the sensor output area. See Figure C-7. Sensor output details can also be seen by selecting the sensor from the current sensors panel. The **Bring In** button can be used to return the sensor.

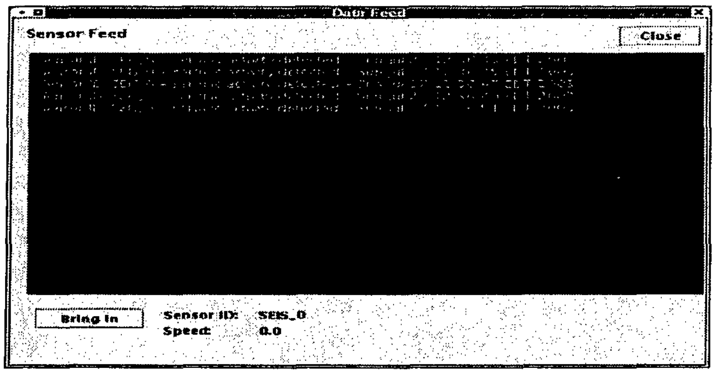

Figure C-7. Audible sensor output.

2. Audible sensors will alert the user of activity in the sensor output area via a text message in the sensor output area. To listen to the sound recorded, bring up the current sensors panel and click the **Audible Sensor**. Then click the **Play** button. The **Bring In** button can be used to return the sensor. See Figure C-8.

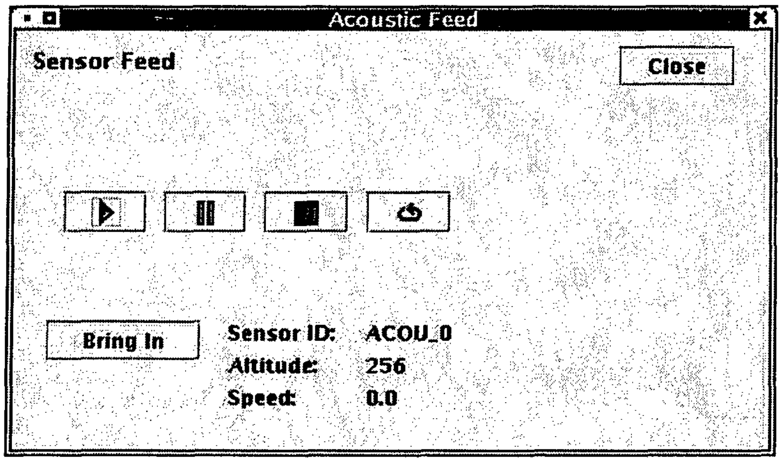

Figure C-8. Audible sensor controls.

3. Visual sensors provide visual images that are only accessible through the current sensor panel. See Figure C-9. To view the images, click on the sensor in the current sensor panel. While the sensor output window is open, the image will update based on the position of the sensor in the map. The **Bring In** button can be used to return the sensor.

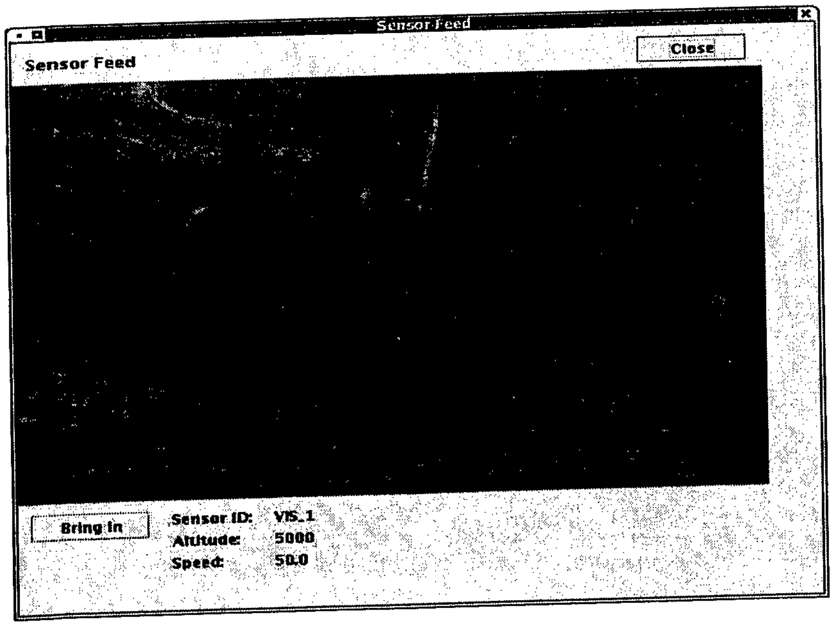

Figure C-9. Visual sensor image.

4. Biological agent sensors will alert the user to agents detected via a text message in the sensor output area. You can select the sensor from the available sensors panel to view specific details. The **Bring In** button can be used to return the sensor.

Appendix D

Concept-Development Session Specifications

CONCEPT-DEVELOPMENT SESSION 1 SPECIFICATION

Title	What do you want to know, how do you want to learn it?
General description	This concept-development session provides an opportunity to explore elements of the "SEE" function in relation to a civilian cultural situation and allow for a wide range of responses from the participants. This concept-development session is for participants playing the role of the UA Reconnaissance Squadron Commander. The participants are presented with a tactical scenario, which includes a detailed written account of civilian activities in a town known to harbor threat personnel on existing blacklists. They are also able to view a series of photographs including groups of armed persons congregated near the town's central hall. They have access to maps along with graphic displays showing their unit task organization and additional assets available. They are told that the unit's task in this situation is to determine the nature of the threat in the town and make a report to the Battalion Commander.
Data collection	The structured interview, conducted by moderator(s), elicits responses aimed at shaping concepts and tactics, techniques, and procedures (TTP) related to this situation, including items such as determining what types of information they needed, how that information could best be presented, what steps they would take to accomplish the task, and what, if any, additional assets might have enhanced their performance. The moderators collect additional process data as they observe the participant completing the concept-development session. They record actions taken by the participant such as what information was reviewed and for how long, whether or not the mapping tool was used, etc., that might be helpful in conducting the interview or in interpreting the participants responses to the interview.
Data analysis	Data collected during the structured interview(s) will be analyzed by a panel familiar with Future Force UA concepts developed thus far as presented in the UA Operational and Organizational (O&O) Plan and the operational requirements document (ORD) for Future Combat Systems (FCS). Qualitative analysis procedures and techniques will be used and, as stated previously, the results will be used to modify the concept-development session for additional presentations. At some point determined by the panel, the concept-development session will no longer be administered and the concepts, TTP, lessons learned, etc., from all administrations of the concept-development session will be documented.

Structured interview questions	1. The unit's task in this concept-development session was to determine the nature of the threat and report to the Battalion Commander. What steps would you take to complete this task? (Follow-up and clarify as necessary). 2. What additional assets/capabilities, if any, would you liked to have had to complete this task, and how would you have employed those assets? 3. Is there information that you did not have that would have helped you complete this task? What information? How could it best be presented? 4. Is this an appropriate task for the unit indicated? Should it be a higher level task? Lower level? 5. Follow-up questions based upon observations of the moderators.

CONCEPT-DEVELOPMENT SESSION 2 SPECIFICATION

Title	**Design intuitive summary graphics for the Common Operational Picture (COP)**
General description	This concept-development session provides an opportunity for participants to design and create sample intuitive summary graphics (ISGs) for use on future planning maps and the COP. It focuses on ISGs for use at Bde level. Subsequent iterations may be conducted to design ISGs for Bn and Company/Troop level. An ISG is a symbol or icon displayed as part of a command and control system. They are simple to understand and informative, and provide the viewer with enough information to quickly grasp the nature of the event, unit, activity, terrain feature or effect being depicted. Examples of some current graphics that could be considered as ISGs include: military unit symbols and graphic control measures, international traffic/safety symbols, and the closed envelope representing email on many computers. In the near future it will be possible to clearly display multi-color, composite symbols using computers. The creation of a set of well-defined, easy to understand ISGs is required to ensure the military makes the best use of available computer capabilities and provides its personnel with one-look-to-understand graphics. This session includes two methods for the design/creation of intuitive summary graphics. One consists of the participant being presented with a series of spot reports in text. The participant is asked to design a graphic that represents the information in the reports. In the second method the participant is presented with a series of photographs and/or drawings of military activities and asked to design a graphic that represents the activities. In both methods the participant has a number of tools available to help with the design/creation of the graphics. These include but are not limited to drawing tools such as Microsoft PowerPoint®, a set of graphics to start with (such as boxes, lines, vehicles, personnel), a white board and markers, and current military symbology manuals. Additionally, there is graphic designer on hand to assist in developing the proposed ISGs in PowerPoint or a similar drawing application. This will support the recording and saving of the ISGs for future use.
Data collection	Data collected for this concept-development session consists primarily of the ISGs produced by the participants. These are collected either electronically or by drawing or photographing the white board used by participants. All ISGs produced are digitized for storage and retrieval. In addition, participants are observed as they complete the concept-development session and participate in a structured interview conducted by the moderator(s). The interview will primarily elicit responses to determine the decision-making process participants use to design ISGs.

Data analysis	Data from this session will consist of graphic images. These will be presented to a panel familiar with Future Force concepts who will select those that clearly represent their underlying concept.
Structured interview questions	1. Your task in this concept-development session was to develop or design intuitive summary graphics that reflected the situation presented either in text or graphically. Can you describe the thought process you went through for accomplishing this? 2. Was the description of the situation, either in text or graphics, complete enough for you to do your task? Explain. 3. Follow-up questions.
Note	To use this concept-development session as a shell for developing other ISGs, it was developed so that the situation as presented in text or graphics can be easily changed. This allows a virtually unlimited range of situations to be developed and presented to participants resulting in the production of an unlimited number of ISGs.

CONCEPT-DEVELOPMENT SESSION 3 SPECIFICATION

Title	**What information should a COP include? (Develop a COP)**
General description	This concept-development session provides an opportunity to explore elements of the "SEE" function related to the development of a brigade COP. It is designed for Future Force designers and developers? In this concept-development session the participant(s) are shown a representation of a COP at brigade level that consists of multiple information layers with intuitive summary graphics representing operations graphics, the threat situation, terrain effects, etc. The participants are provided with a brief tactical scenario and associated operations graphics on a two dimensional map. They are then shown various other graphical overlays (threat, fires, obstacles, etc.), intuitive summary graphics, reports, messages, and sensor feeds related to the tactical situation and asked which of the additional pieces of information presented should be used to create the COP. They are also asked to recommend how the information should be displayed and what control the user or viewer of the COP should have in selecting what information is displayed. The COP represents a current tactical situation for a brigade conducting offensive operations in a major theater war (MTW) against a threat representing the new Operational Environment. The participant(s) are asked to evaluate the usefulness of each layer individually and in multiple combinations. The participant(s) are encouraged to request different combinations of layers during the concept-development session. The task is to provide suggestions for improving the clarity of the COP. This concept-development session is highly interactive between the participant and the moderator(s). This is necessitated by two factors: the moderator displays various preplanned information to the participant and asks for reactions; and the participant may wish to display unplanned information, but will probably not be familiar with the concept-development session software in order to create the display himself. Thus, during the conduct of the concept-development session, the moderator not only displays information to the participant, he/she is also recording the participants' observations, reactions, and inputs on an on-going basis. The moderator uses a structured data-collection form to capture data.

Data collection	The primary data collected from this concept-development session are the "finished COPs," i.e., the COPs that the participant determines as the best representation of the situation at the brigade level. The COPs are captured graphically with sufficient annotations to provide clarity for any subsequent analyses. Additional data are obtained from the interactive data collection that takes place as the concept-development session proceeds and follow-up interviews.
Data analysis	The completed COPs, along with data collected during the conduct of the concept-development session and during subsequent interviews, are analyzed by a panel familiar with the Future Force UA concepts. Qualitative analysis procedures and techniques are used and, as stated previously, the results are used to modify the concept-development session for additional presentations. At some point determined by the panel, the concept-development session will no longer be administered and the concepts and recommendations for presenting the COP will be documented.
Structured interview questions	1. Your task in this concept-development session was to develop a brigade level COP for a Future Force operation. What was your rationale for including the information you did? How well do you think the COP you produced will work? 2. What, if any, important information is missing from the COP? 3. Who should be allowed to make changes to the COP? Explain. 4. Is there a single COP that will serve all echelons? Explain. 5. Follow-up questions based upon observations of the moderators.

CONCEPT-DEVELOPMENT SESSION 4 SPECIFICATION

Title	**What is the process for updating COPs?**
General description	This concept-development session provides an opportunity to exercise portions of the "SEE" function in relation to the updating of the COP and allow for a wide range of responses from the participant(s). This concept-development session explores the preferences, requirements, and ideas of the participant(s) centered on what they see as the process for adding, deleting or modifying information appearing on the COP. The participant(s) are provided with a graphical representation of a current brigade COP (e.g., the product from concept-development session #3) and given time to review and understand the information on the COP. The participants are provided with a series of tactical reports and messages from various units/personnel and are asked to decide which ones should be added to the brigade COP and whom they think should control the updates to the brigade COP. The participant(s) are then asked to describe what they see as a viable process for updating the brigade, battalion, or company COPs during combat operations.
Data collection	Participants are provided with a questionnaire which they fill out as they complete the concept-development session. The questionnaire prompts the participant to decide, for each of the reports and messages, which should be added to the COP and by whom. Participants are also observed by moderator(s) as they complete the concept-development session, after which they will participate in a structured interview. The interview elicits responses aimed at shaping concepts related to updating the COP.
Data analysis	Data collected from the participant-completed questionnaires, the observations and during the structured interview(s) is analyzed by a panel familiar with Future Force UA concepts developed thus far as presented in the UA O&O and the ORD for FCS. Qualitative analysis procedures and techniques are used and, as stated previously, the results are used to modify the concept-development session for additional presentations. At some point determined by the panel, the concept-development session will no longer be administered and the concepts, lessons learned, etc. from all administrations of the concept-development session will be documented.

Structured interview questions	1. Your task in this concept-development session was to determine what information should be added to a brigade COP and by whom. In general, are there some rules or procedures you can think of for deciding what information gets added? Explain. 2. In general, are there some rules for deciding who can modify the COP? Explain. 3. Do these rules and procedures apply to COPs at other echelons? Explain. 4. Follow-up questions based upon observations of the moderators.

CONCEPT-DEVELOPMENT SESSION 5 SPECIFICATION

Title	**Use Commander's Critical Information Requirements (CCIR) to determine sensor requirements**
General description	This concept-development session provides an opportunity to explore elements of the "SEE" function related to the development of Future Force sensor requirements and usage. It allows for a wide range of responses from the participants. The concept-development session is developed for participants playing the role of the UA Battalion Commander. The participants are provided with a brief tactical scenario at battalion level, associated operations graphics on a two dimensional map, a set of CCIR pertaining to the tactical situation.
Data collection	After participants work through the scenario, they will participate in a structured interview conducted by moderator(s). The interview elicits responses aimed at shaping concepts and TTP related to this situation including items such as determining what types of sensors they needed and how they would deploy and use those sensors. Participants are also encouraged to identify other (especially non-existent) sensor capabilities that might help answer the CCIR. The moderators collect additional process data as they observe the participant completing the concept-development session. They record actions taken by the participant such as what information was reviewed and for how long, etc. that might be helpful in conducting the interview or in interpreting the participant's responses to the interview.
Data analysis	Data collected during the concept-development session and during the structured interview(s) are analyzed by a panel familiar with Future Force UA concepts developed thus far as presented in the UA O&O and the ORD for FCS. Qualitative analysis procedures and techniques are used and, as stated previously, the results are used to modify the concept-development session for additional presentations. At some point determined by the panel, the concept-development session will no longer be administered and the concepts, TTP, lessons learned, etc. from all administrations of the concept-development session will be documented.
Structured interview questions	1. Your task in this concept-development session was to examine the tactical scenario and CCIRs and to decide what types of sensors would be important or useful in responding to the CCIRs. 2. What additional sensor capabilities not included in the list would you want to have? How would you use them? 3. Does the idea of tying sensor capabilities to CCIRs make sense? Explain. 4. Follow-up questions based upon observations of the moderators.

CONCEPT-DEVELOPMENT SESSION 6 SPECIFICATION

Title	**Assess an urban area, what is the right sensor to human mix for ISR?**
General description	This concept-development session provides an opportunity to explore elements of the "SEE" function in relation to the assessment of an Urban Area. The participants will be playing the role of the UA Combat Aviation Brigade (CAB) RSTA Company commander. Participants are presented with a scenario that includes the requirement for the unit to conduct the initial assessment (ISR) activities of a town known to harbor threat personnel and equipment. Participants have access to maps and a series of photographs and sketches of the town. Additionally, they are provided with graphic displays showing their available assets. They are told that the unit's task in this situation is to conduct an assessment of the town and make a report to the Battalion Commander. The participants are asked to develop a concept for employing their assets. This session focuses on the optimal mix of robotic sensors to human reconnaissance assets.
Data collection	After participants work through the scenario, they participate in a structured interview conducted by moderator(s). The interview elicits responses aimed at shaping concepts and TTP related to this situation including items such as determining what types of information they needed, how that information could best be presented, what steps they would take to accomplish the task, and what, if any, additional assets might have enhanced their performance. The moderators collect additional process data as they observe the participant completing the concept-development session. They record actions taken by the participant that might be helpful in conducting the interview or in interpreting the participant's responses to the interview.
Data analysis	Data collected during the structured interview(s) are analyzed by a panel familiar with Future Force UA concepts developed thus far as presented in the UA O&O and the ORD for FCS. Qualitative analysis procedures and techniques are used and, as stated previously, the results are used to modify the concept-development session for additional presentations. At some point determined by the panel, the session will no longer be administered and the concepts, TTP, lessons learned, etc. from all administrations of the session are documented.

Structured interview questions	1. The unit's task in this concept-development session was to conduct an assessment of the town and make a report to the Battalion Commander. What steps would you take to complete this task? (Follow-up and clarify as necessary.) 2. You were asked to develop a concept for employing your assets – both human and robotic. Describe and explain your concept for employing assets. 3. What do you think is the best mix of human and robotic assets for completing this task? 4. Follow-up questions based upon observations of the moderators.

CONCEPT-DEVELOPMENT SESSION 7 SPECIFICATION

Title	**Which reconnaissance asset(s) are needed to conduct reconnaissance in and around caves and cave-like structures?**
General description	This concept-development session provides an opportunity to exercise portions of the "SEE" function in relation to a tactical situation that requires the reconnaissance of a cave complex. This session allows for a wide range of responses from the participants by exploring the anticipated requirements for conducting reconnaissance of caves and cave-like structures (sewers) during combat operations. It is for participants playing the role of the UA Battalion Commander. The participants are provided with a brief tactical scenario that includes the requirement for their battalion to conduct reconnaissance of suspected threat locations in a mountainous area that includes a series of small and large caves. They are also provided with photos of the exterior and interior of the cave complex. They are then asked to identify and prioritize the sensor capabilities they expect will provide the best reconnaissance results. The outcome of this concept-development session is a list of desired sensor capabilities that the participants believe are best suited to use in caves and cave-like structures.
Data collection	After participants work through the scenario, they will participate in a structured interview conducted by moderator(s). The interview will elicit responses aimed at shaping concepts and TTP related to this situation including items such as determining what types of information they needed, how that information could best be obtained, and what steps they would take to accomplish the task.
Data analysis	Data collected during the structured interview(s) are analyzed by a panel familiar with Future Force UA concepts developed thus far as presented in the UA O&O and the ORD for FCS. Qualitative analysis procedures and techniques are used and, as stated previously, the results are used to modify the session for additional presentations. At some point determined by the panel, the concept-development session will no longer be administered and the concepts, TTP, lessons learned, etc. from all administrations of the concept-development session will be documented.

Structured interview questions	1. Your task in this concept-development session was to develop a list of desired sensor capabilities that you think are best suited to use in caves and cave-like structures. What information provided was important in helping you decide the sensor capabilities required? 2. Was there additional information that you would have liked to have had? How would it have assisted you in making your decisions? 3. What are the most important sensor capabilities you would need for the situation described? 4. Given that you had all of the sensor capabilities you have listed, describe a typical scenario for how you would deploy and use them in this situation. 5. Follow-up questions.

CONCEPT-DEVELOPMENT SESSION 8 SPECIFICATION

Title	Fuse information from multiple sources
General description	This concept-development session provides an opportunity to explore elements of the "SEE" function. The session is for participants playing the role of a UA combat assessment (CA) Battalion Commander. It will explore the cognitive processes associated with the fusion of information from various sources and allows for a wide range of responses from the participants. The participants are presented with 2-3 sets of information related to a tactical operation via a computer and in a variety of ways to include text, video, audio, and graphics. The information consists of tactical reports from recent threat activity that is relevant to the participant's unit. The information is unfiltered and in some cases redundant or overlapping. In other instances, the information is incomplete when considered alone but relevant when fused with related information. The participants are allowed to review the situation and all supporting materials for as long as they want, after which they develop a situation report or verbal summary and ISG for each information set.
Data collection	At the completion of the concept-development session, participants will participate in a structured interview conducted by moderator(s). The interview will elicit responses aimed at identifying the cognitive processes involved in fusing information from a variety of sources into a commonly understood tactical situation.
Data analysis	Data collected during the structured interview(s) are analyzed by a panel familiar with Future Force UA concepts developed thus far as presented in the UA O&O and the ORD for FCS. Qualitative analysis procedures and techniques are used and, as stated previously, the results are used to modify the concept-development session for additional presentations. At some point determined by the panel, the concept-development session will no longer be administered and the concepts, TTP, lessons learned, etc. from all administrations of the concept-development session will be documented.

Structured interview questions	1. Your task in this concept-development session was to develop a picture of the tactical situation based on information from a variety of sources. Can you describe how you went about doing this (that is, can you describe the steps you took mentally in fusing the information from the various sources)? 2. Did the ways in which the information was presented to you help you with the fusion process? Did they hinder you? Did they make a difference one way or the other? 3. Are there different ways you would prefer to have the information presented to you? Explain. 4. What information is critical to the fusion process? 5. Is there information that is routinely presented that is not important to the fusion process? Explain. 6. Are there automated tools that you can think of that would assist you with the fusion process? Explain. 7. Follow-up questions.

CONCEPT-DEVELOPMENT SESSION 9 SPECIFICATION

Title	Action – reaction – counteraction upon entering an immature AO
General description	This concept-development session provides an opportunity to explore elements of the "SEE" function in relation to the use of organic unit sensors for terrain reconnaissance as an initial task upon entering an immature AO. The session is for participants playing the role of the UA CA Battalion Commander. One premise for FCS-equipped units is that they will be required to conduct terrain reconnaissance using organic sensors as one of their initial tasks upon entering an AO. The goal of the reconnaissance is to update data on the terrain in the AO since many maps and terrain databases will be outdated or incomplete. The question this raises is: if it is part of our doctrine to conduct such reconnaissance upon entering an AO, what will the threat's reaction be and what should our counteraction be? For instance, if the threat knows we always do a sensor-based terrain reconnaissance at the outset of operations, how will they use this information? Will they sit tight and monitor our sensor use patterns and identify our tactics and procedures? If so, how will we counter this and maintain the advantage provided by our sensor capabilities? The participant(s) are presented with a short tactical scenario that has their unit entering an immature AO as the lead unit of a UA brigade. They are also provided with a task organization and system capabilities matrix for the battalion. The battalion is tasked with securing an entry point and conducting a detailed terrain reconnaissance of the brigade AO using its organic sensors and selected brigade sensors attached to the battalion. The scenario includes information concerning the threat's composition, disposition and recent activities. The threat consists of a lightly equipped but sophisticated thinking enemy who uses its forces to strike at key government and military targets only. The threat also conducts extensive propaganda and recruiting activities, both of which have been successful. The task of the participants in this concept-development session is to do some informed speculating about actions our forces and threat forces are likely to take in the described situation. They will be attempting to answer questions such as: "What actions should we take upon entry into the AO? If we do this, what do you think the threat will do? If the threat does this, what should our response be?"

Data collection	Participant responses will be captured by the moderator(s) throughout the concept-development session, moderators will record their responses/actions as a military subject matter expert (SME) leads them through the thought processes involved with completing it. In addition, they participate in a structured interview conducted by moderator(s) after they have completed the concept-development session. The interview elicits responses aimed at clarifying and/or expanding the data collected as the concept-development session was completed.
Data analysis	Data collected during the completion of the concept-development session and from the structured interview(s) are analyzed by a panel familiar with Future Force UA concepts developed thus far as presented in the UA O&O and the ORD for FCS. Qualitative analysis procedures and techniques are used and, as stated previously, the results are used to modify the concept-development session for additional presentations. At some point determined by the panel, the concept-development session is no longer to be administered, and the concepts, TTP, lessons learned, etc., from all administrations of the concept-development session are documented.
Structured interview questions	Go through the actions and responses taken by the participant and ask any follow-up questions needed to clarify or add to the data you recorded during the completion of the concept-development session.

CONCEPT-DEVELOPMENT SESSION 10 SPECIFICATION

Title	Deploy a UA battalion in an AO to conduct reconnaissance operations
General description	This concept-development session provides an opportunity to explore elements of the "SEE" function in relation to TTP associated with the deployment of a UA battalion and allow for a wide range of responses from the participants. The concept-development session is for participants playing the role of the UA CA Battalion Commander. The participants are presented with a tactical scenario which requires them to decide how they will employ the battalion over a very large AO to conduct reconnaissance operations in a small scale contingency (SSC). They have access to maps along with graphic displays showing the threat situation, the battalion's assets and various other information. They are told that the unit's task in this situation is to deploy rapidly throughout the AO in a manner that supports conducting an area reconnaissance. Participants are allowed to review the situation and all supporting materials for as long as they want, and, when ready, they are asked to place their units on the map in initial positions and to add any graphic control measures (GCMs) needed. They are also asked to prepare short 'task and purpose' statements for each unit to support their concept of the operation.
Data collection	Once participants complete the session, they participate in a structured interview conducted by moderator(s). The interview elicits responses aimed at shaping concepts and TTP related to this situation including items such as determining what types of information they needed, how that information could best be obtained, and what steps they would take to accomplish the task.
Data analysis	Data collected during the structured interview(s) are analyzed by a panel familiar with Future Force UA concepts developed thus far as presented in the UA O&O and the ORD for FCS. Qualitative analysis procedures and techniques are used and, as stated previously, the results are used to modify the concept-development session for additional presentations. At some point determined by the panel, the concept-development session is longer to be administered, and the concepts, TTP, lessons learned, etc., from all administrations of the concept-development session will be documented.

Structured interview questions	1. Your unit's task in this concept-development session was to deploy rapidly throughout the AO in a manner that supports conducting an area reconnaissance. Describe your rationale for your deployment plan. 2. How was your plan influenced by the mix of live and robotic reconnaissance capabilities you had access to? 3. Was the information you were provided sufficient to allow you to create your reconnaissance plan? Explain. 4. Do you think the reconnaissance plan you produced adequately covers the area involved? Explain. 5. Follow-up questions.

Appendix E

Administration Guide for Concept-Development Sessions for the Future Force

Administration Guide for
Concept-Development Sessions for the Future Force

Introduction

The Army, as it incorporates new technology such as robotics, advanced sensors, and network-centric Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) systems, is beginning a transformation process on a wide scale. A key to success of this transformation is a solid Army process for concept development - a means to generate, elaborate, refine, describe, test, and validate new Future Force concepts relating to doctrine, tactics, techniques, procedures, unit and team organization, job allocation, training, leader development, and other aspects of technology integration. One method for concept development is provided in a tool for presenting concept-development sessions (CDS).

The notion of a CDS is that of a snapshot, or a series of snapshots, or a short presentation that places a decision-making, problem-solving, or evaluation requirement on the participant(s). A CDS, unlike a simulation, is not required to respond dynamically to participant input. The CDS can portray highly realistic situations and entities that are often very difficult to model well in a simulation, e.g., underground caves, car bombs, cultural factors, and situations arising from support and stability operations. The CDSs comprise the presentation of a detailed, realistic situation during which a participant provides concepts and ideas related to the situation portrayed. This may then be followed by "what now?" or "what if?" queries to the participant(s). By running a CDS multiple times, modifying it based on the information collected from participants, and repeating this run-modify process, it will be possible to develop and fine-tune ideas and concepts which can then be used as the basis for additional testing or development using other tools that may be developed.

Structure of CDSs

There are currently 10 CDSs which have been developed using RoboHTML and PowerPoint. They are designed for execution on a system that includes dual monitors. (It is possible to present a CDS on a single-monitor configuration; however, its effectiveness will be seriously degraded.)

In a typical CDS, the component developed in RoboHTML is presented on the left screen, and the component developed in PowerPoint is presented on the right. The RoboHTML component provides descriptive information, often text-based although some is presented graphically as well, that sets the context for the session and provides the background and other details the participant needs to start the "thought" process that is at the heart of the CDS. The PowerPoint component includes the graphics (maps and overlays, pictures, etc.) that support the CDS and provide the richness of detail that helps guide the participant's thought process.

As is probably obvious by now, it is the participants' "thoughts" that are the heart of the CDS. The CDS is designed to capture these thoughts both during and after the execution of the CDS. This is accomplished in two ways. First, the complete CDS session should be videotaped

(or at least audiotaped) so that it can be analyzed for relevant concepts and ideas that may have been elicited. In addition, the observers/moderators should take notes during the execution of the CDS, and should interview the participant after completing the CDS. Each of the CDSs provided includes a data collection instrument to assist the observers/moderators in collecting data during the CDS. A list of the ten CDSs currently developed, along with the echelon for which it was developed and its focus, is provided in Table E-1.

"Running" a CDS

Running a CDS is a straightforward process. The participant(s) should be seated at the display system; the observers/moderators should be seated in a position where they can easily observe the actions being taken without being intrusive. There must be at least one observer/moderator although two are recommended. It is strongly recommended that at least one observer/moderator be a military subject matter expert with a good knowledge of Future Force and FCS capabilities.

Prior to starting the session, copies of the data collection form for the CDS should be provided to each observer/moderator. Use of this guide will be discussed shortly.

At the start of a session, the participant(s) should be briefed on the CDS process. This should include a statement emphasizing that the CDS is not an exercise to be solved, but rather, it is a description of a situation designed to start the participant(s) thinking about how the Army might function in the future. The briefing should also emphasize that the data the CDS is designed to collect are the "thoughts" of the participant(s). For this reason, participant(s) are encouraged to "think out loud" as they go through the CDS. Some participant(s) will be more comfortable doing this than others, and those who prefer not to do it should not be forced to do so. The participant(s) should be encouraged to think "future" and should be told that there are no correct or incorrect answers. The purpose is to "see what they think." Following the initial brief, the observer/moderator should start the CDS.

The initial page or screen of each CDS provides general instructions for completing it as well as describing the specific task the participant(s) is completing. After reading this page, the participant(s) will start the CDS. As the session proceeds, the observer/moderator should record significant actions the participant(s) takes as well as what he or she is saying, questions he or she asks, etc. using the data collection form provided for each CDS. If appropriate, and this is a judgment call, the observer/moderator can direct the participant(s) to certain features or aspects of the CDS or can even ask direct questions to attempt to lead the participant(s) in a specific direction. You need to be careful if you do this however, since you don't want to unduly influence the thought processes of the participant(s) or influence them to think the way others have responded or the way you think. A good rule of thumb to remember is "you already know what you think; the purpose of the CDS is to find out what they think."

Another important point to keep in mind while observing is to be patient. If you do ask a question or otherwise prompt the participant(s), give them plenty of time to think about their

response. Avoid the temptation to ask a quick follow-up question if they don't respond immediately.

Also keep in mind that you do not need to ask every question immediately as it occurs to you. If a question comes to mind that you can ask after the participant(s) has completed the CDS, write it down on the observation form. Your purpose is to observe, not to unduly influence – to allow the participant(s) to fully explore their line of thought without interrupting in a way that takes them into a different line of thought.

It is anticipated that the CDS will go through a progressive life cycle. Specifically, it will be administered several times with single participants. The ideas gleaned from those administrations might then be incorporated into the CDS, and it will be administered with more participants, possibly two or more at a time. As more and more data are obtained the CDS is modified and administered until it reaches a point where no new information is forthcoming. At this point, the CDS has probably told you everything it is going to as far as concept development is concerned, and it may well become the basis for some kind of training exercise or other Future Force development tool.

Analyzing Data from a CDS

The final part of CDS administration involves analyzing the data obtained from the participant(s). Since each administration of a CDS will probably be different from all other administrations of that CDS, it is difficult to have a specific set of items that you can record and enter into a database. It is much more likely that you will go back over the responses produced in an administration of a CDS and "content analyze" them for important or critical points. It is these points that would be entered into a database to allow you to go back later and look for commonalities across participants, critical ideas, etc. Just keep in mind that if you change or modify the CDS substantially, you will need to be careful about comparing responses from the two different versions.

Table E-1. Current Concept-Development Sessions.

#	Title	Echelon	Focus
1	What do you want to know, how do you want to learn it?	Troop	Use of assets to identify nature of civilian gathering in a potentially hostile town.
2	Design Intuitive Summary Graphics for the COP.	Brigade	Identifying characteristics of good useful ISGs.
3	What information should a COP include?	Brigade	Identifying characteristics of a useful COP.
4	What should the process be for updating the COP?	Brigade, Battalion, Company	Identifying processes for managing the updating of COPs at various echelons.
5	Use CCIR to determine sensor requirements.	Battalion	Determining how CCIR could influence design of future sensors.
6	Assess an Urban area – what is the right sensor to human mix for ISR.	Company	Identifying concept for mixing robotic sensors with humans during ISR of urban areas.
7	Which reconnaissance asset(s) are needed to conduct reconnaissance in and around caves and cave-like structures?	Battalion	Identifying sensor capabilities to support ISR
8	Fuse information from multiple sources for display on the COP.	Battalion	Identify cognitive approaches to fusing information.
9	Action – reaction – counteraction upon entering an immature AO.	Battalion	Identify possible threat reactions to US use of robotic sensors.
10	Deploy a CAB in an AO to conduct reconnaissance operations.	Battalion	TTP associated with deployment of a UA CA battalion in a very large AO.

Modifying a CDS and Developing a New CDS

It is not difficult to modify a CDS, although it does require knowledge of RoboHTML and PowerPoint. If you simply want to change the information on a given page, you can edit the appropriate file from the list of files that were developed to make up the compiled CDS. More extensive modifications could involve making new files using RoboHTML and/or new PowerPoint slides.

Developing a new CDS involves starting from scratch with designing the CDS as the first step. It is important to develop design specifications that include a description of the CDS scenario, the focus of the CDS, the concepts it is intended to explore, and so forth. Once the design is complete, development can proceed using RoboHTML and PowerPoint.

Keep in mind that if you do significantly modify a CDS or create a new one, you will need to develop appropriate data collection instruments.